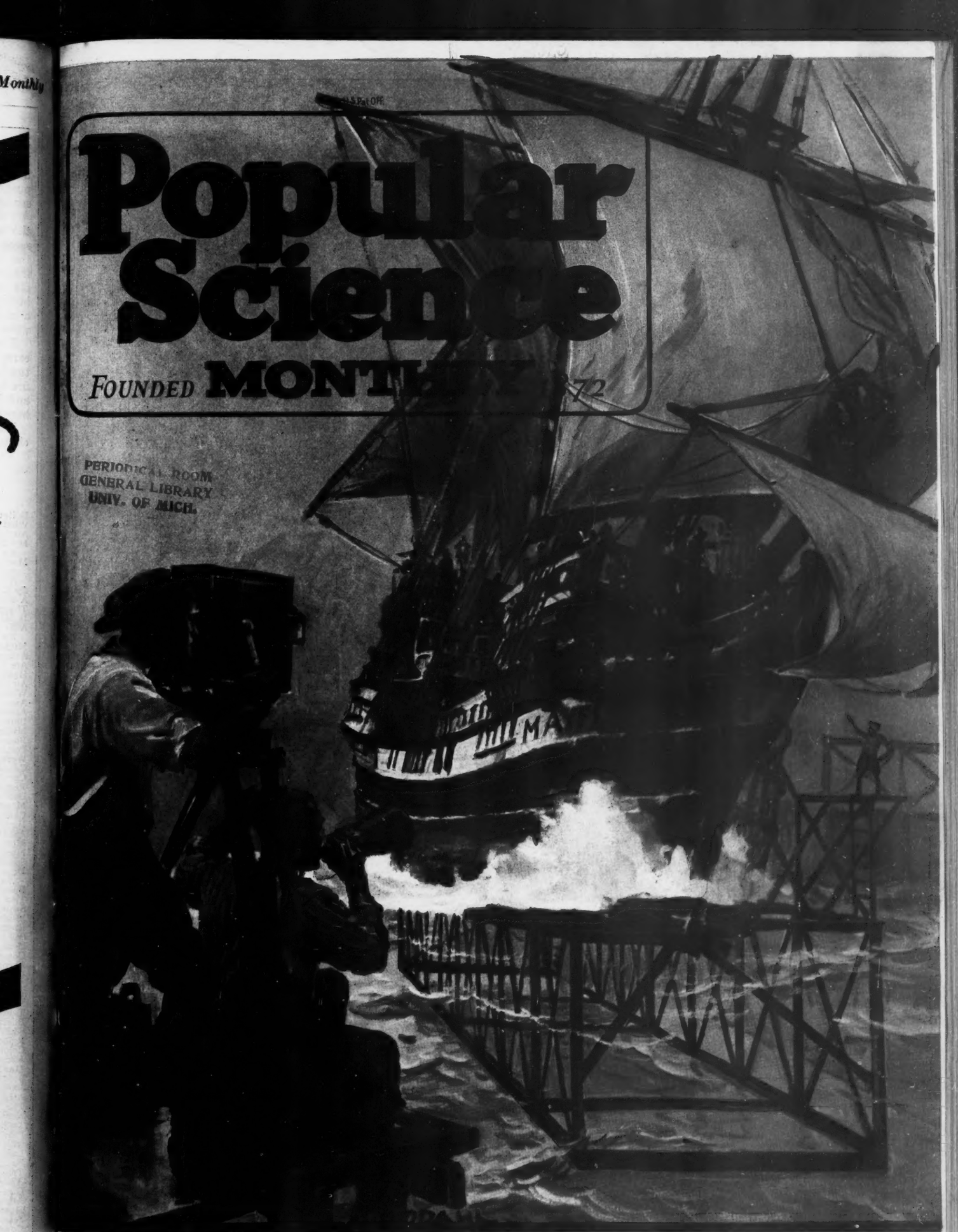

JUNE

Movie Mayflower Rides Mechanical Waves—page 47

25 CENTS

How Science Traces Our Monkey Ancestry (page 28)

Some of the Exclusive (patented) Comfort Giving Features that contribute to the popularity of the "B.V.D." *Union Suit*

"B.V.D." *shaped* elastic insertions at *shoulders* and *encircling waist* make these cool, loose-fitting undergarments *instantly responsive* to your slightest movement. These *ever-elastic* insertions are knitted by us on spring needle machines from yarns spun from *selected* cotton in our own yarn mill.

"B. V. D." elastic reinforcement in the back of the waist band immeasurably strengthens the wear of the garment at the point of greatest strain.

The perfect "B. V. D." closed crotch completely covers the crotch and gives sufficient seat opening without *surplus trunk length* and uncomfortable needless material at crotch.

Union Suits
Men's, $1.50 and upward the suit
Youths', 85c the suit

They know why they prefer "B.V.D."

THOSE clear thinking fellows who have found that it pays to keep "fit as a fiddle" are especially exacting in matters of personal comfort. They value the Unvarying Quality, Famous Fit and Long Wear assured by the "B.V.D." Red Woven Label.

From raw material to finished product we practice ceaseless care so that every "B.V.D." garment is of the quality that has brought world-wide preference for our product.

The cool, durable nainsook of "B.V.D." is woven in our own mills from selected cotton and finished in our bleachery.

In our factories vigilant inspection guards every process of skillful cutting, sturdy stitching, well-sewn buttons and accurate finish.

There is only one "B.V.D." Underwear
It is always identified by this Red Woven Label

MADE FOR THE B.V.D. BEST RETAIL TRADE

Trade Mark Reg. U.S. Pat. Off. and Foreign Countries

The B.V.D. Company, Inc., New York
Sole Makers of "B.V.D." Underwear

LOOSE-FITTING "B.V.D." *Coat Cut Undershirts and Knee Length Drawers* are the "standby" of millions of men who wear two piece underwear

"B.V.D." is the constant choice of these men because they know that "B. V. D." Coat Cut Undershirts and Knee Length Drawers are correctly cut as to size and that there is a shapeliness to the garments that makes them hang smoothly and evenly with neither too much nor too little fulness.

The garments are tailored with noticeable balance and drape, retaining both, no matter how long worn or how often washed.

These "B. V. D." garments are reinforced at points of possible strain — all seams sewn with lockstitch throughout and cannot unravel.

Undershirts and Drawers
85c and upward the garment

© 1923, The B.V.D. Company, Inc.

"NEXT TO MYSELF I LIKE B.V.D. BEST"

If you bought only *one* new Victor Record a week

Victrola No. 300
$250
Victrola No. 300, electric, $290
Mahogany, oak or walnut
Other styles $25 to $1500

you would have such a treasury of music as could compare only with the great libraries and the great art galleries of the world. You would have a source of untold satisfaction for your every need. The musical genius of the world is graved on Victor Records—not the printed page of music, but the music itself.

Victrola

"His Master's Voice"

Look for these trade-marks. Under the lid. On the label.
Victor Talking Machine Company, Camden, N.J.

POPULAR SCIENCE MONTHLY

JUNE, 1923; Vol. 102, No. 6
25 cents a Copy; $2.50 a Year

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225 West Thirty-ninth Street

MEN and insects are engaged in a bitter struggle for control of the world. The story is told on page 34. Men have overcome most animate forces. But these vigorous and industrious organisms still attack us from every point. They are our greatest rivals in the control of nature. They are shortening our food supply. They threaten life itself. Some eminent biologists believe that unless science stops their ravages, they will push us off this planet and become its dominant form of life.

* * *

THE idea is not as fantastic as it at first seems. Insects are millions of years older geologically than men. They persist because they are better fitted basicly than men for existence on earth. They are protected with defensive armor, multiply rapidly, and conceal themselves easily. Because of their smallness, men have neglected the dangers they present. Now they are resisting us. If they should defeat us, one wonders if, when the last man is gone, the insects will harness the sun's rays and make microscopic engines to use the tremendous energy of atoms.

* * *

BUT there is comfort in science. This is demonstrated in this month's chapter of "The Story of Man and His World" on page 28. It unravels the history of man across the hundreds of thousands of years. Read it. See how science helped the progress of mankind along the way. See how man conquered the world because his mastery of science brought its forces under harness. Stop and consider the airplane, radio, the automobile and the skyscraper. All of these have come from the laboratory into every-day use in our lifetime. The whole story of man shows that where there are human brains, human necessity will be met.

* * *

BASEBALL players of today are not better men than those of 25 years ago. But to the game, in that period, has come "inside baseball"—science. Col. T. L. Huston, one of the owners of the New York Yankees, discusses on page 40 this science of baseball. Much as science has done for the sport, the future offers greater possibilities. The McGraw of the next generation may use speed-testing machines, time measuring instruments, and brain-testing equipment to choose his players.

* * *

A STORY of an insidious old ogre is that told by Doctor James J. Walsh, famous scientist, on page 23. Unlike the ogres of fairy tales, this one is real—very real. His name is *Fear*. He penetrates every home in the country and eats at the hearts and minds of men and women. He clutches at the will, weakens the muscles, and depresses the brain. Ignorance is his weapon. But, as Doctor Walsh points out, science has a stronger weapon in *Knowledge*. And as men and women grow wiser, and lean more heavily on science, the ogre's strength diminishes. Soon it will be as old fashioned to worry as it is for women to wear bustles.

* * *

CONSIDER your body—the mechanism you are trusting to see you through life. It is the most wonderfully constructed and intricately made machine in the world. Regular exercise is the lubrication that keeps it in smooth running order. Are you keeping your machine in repair or are you letting it rust and wear away? Remember the billions of pores through which your body breathes. Exercise helps them get this breath, which is as necessary to life as that of the lungs. Look over the series of exercises demonstrated on page 44 by Senator Royal S. Copeland, until recently New York's health commissioner. Try them.

* * *

HOW much do you know about science? It is the greatest power on earth. Its inventions and discoveries are constantly changing human life. Study of science is good fuel for the brain. The brain must have fuel to function properly. No machine ever produced power without being fed. Turn to page 46 and find out how much you know of science.

See Table of Contents on page 119

POPULAR SCIENCE MONTHLY

Issued monthly. *Single copy*, 25 cents. *Yearly subscription to United States, its possessions, and Canada*, $2.50; *foreign countries*, $3.

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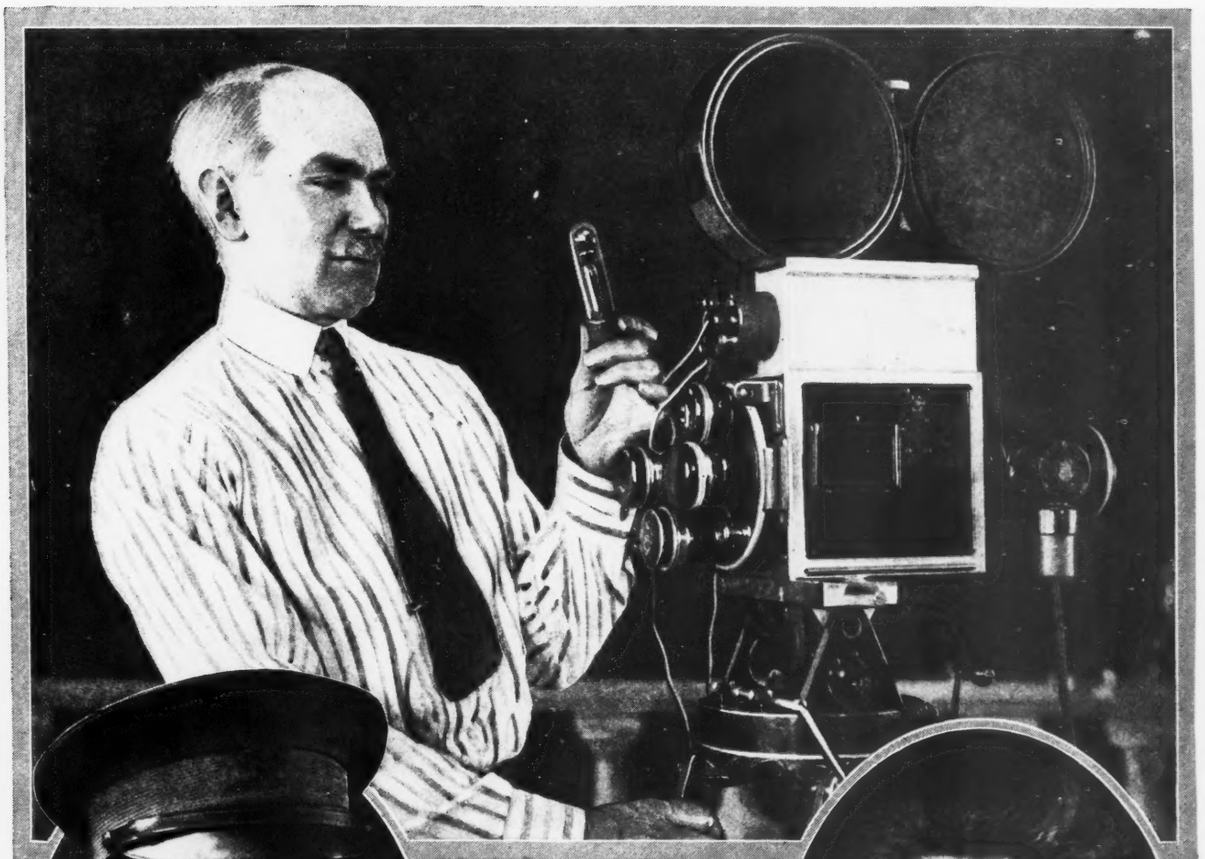
THEY SAY—Brief Bits of Comment by Men of the Hour in Science



DR. LEE DEFOREST, scientist and inventor, who recently demonstrated successfully his new phonofilm, or "talking movie" machine shown above:

"I don't expect this machine to replace the speaking stage or silent movies. But I claim it makes possible a new form of screen drama by introducing music and voice here and there to produce dramatic and artistic effects."

© *The Times-World*

WILLIAM W. KEEN, M.D., Emeritus professor of Surgery, Jefferson Medical College, Philadelphia:

"I hope to dispel the fears of some earnest Christian people that 'Science and the Scriptures' are incompatible. I find no difficulty in believing in both. Every year in a very long life, devoted especially to scientific teaching and writing, has only strengthened my belief in both.

"To me and to many another believer in Evolution, the Bible is the Book of Books. It is a precious manual of Religion but not a textbook of science. It lays down rules of conduct. It is an inspirer of Christian faith and hope. It is the great revealer of God to man through Jesus Christ."

From "I Believe in God and Evolution," by Doctor Keen, published by J. B. Lippincott Company, Philadelphia, Pa.

ALFRED LUCAS, Director of the Chemical Department of the Egyptian Government, engaged in treating chemically the ancient objects taken from King Tutankhamen's tomb:

"The idea that there was anything supernatural about the death of Lord Carnarvon is all bosh."

PROFESSOR ALBERT EINSTEIN, famous German scientist, announcing his newest theory—a startling extension of his theory of relativity:

"I can tell you in one sentence what it is about. It concerns the connection or relation between electricity and gravitation. It is grounded on the theoretical speculations and discoveries of the English astronomer, Eddington. It is a purely mathematical theory, and therefore unexplainable to a layman.

"The relation of electricity to gravitation might be stated in this way: Mathematically the two kinds of fields—electrical field and gravitational field—are placed under a uniform viewpoint. The layman may understand by this, in other words, that the electrical and gravitational fields are one and the same thing mathematically. The theory is an extension of the relativity theory."

"He who lightly promises, is sure to keep but little faith"-Lao Tzu
Wink knowingly at him who would sell you something just as good as a
Grebe Receiver
Doctor Mu.
A. H. GREBE & CO., Inc.
Richmond Hill, N. Y.
Western Branch
451 East 3rd Street, Los Angeles, Cal.
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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
JUNE, 1923

FEAR—Man's Greatest Bogie

What It Does to Us; How to Conquer It; Every-Day Dreads that Undermine Health, Hamper Success, and Take the Joy out of Life

By James J. Walsh, M.D., Ph.D., Sc.D.
Professor of Physiological Psychology, Cathedral College, New York

AN expedition sent to South America by the American Pharmaceutical Association has just announced the discovery of a drug plant believed to be a cure for fear.

If experiments bear out this belief, the new drug should prove one of the greatest boons to mankind.

In this article Doctor Walsh, eminent New York physician and psychologist, points out how indulgence in needless fears is a cause of much ill health.

What he says is not theory. His statements are based on tests made by himself and other scientists.

PHYSICIANS have come to realize in recent years that more than half the ills from which mankind suffers are due more to fears and dreads than to the actual ailments themselves.

Fear is one of man's greatest enemies. Nothing else causes so much mental suffering or so exaggerates physical pain and discomfort as this needless bogie. Happiness, good health, and success are impossible to one laboring under its distress.

Fears, or dreads as they are called in medical terminology, or phobias in scientific language, are extremely common disturbers of the peace of mankind.

The commonest of fears, typical of all others, is the dread of heights.

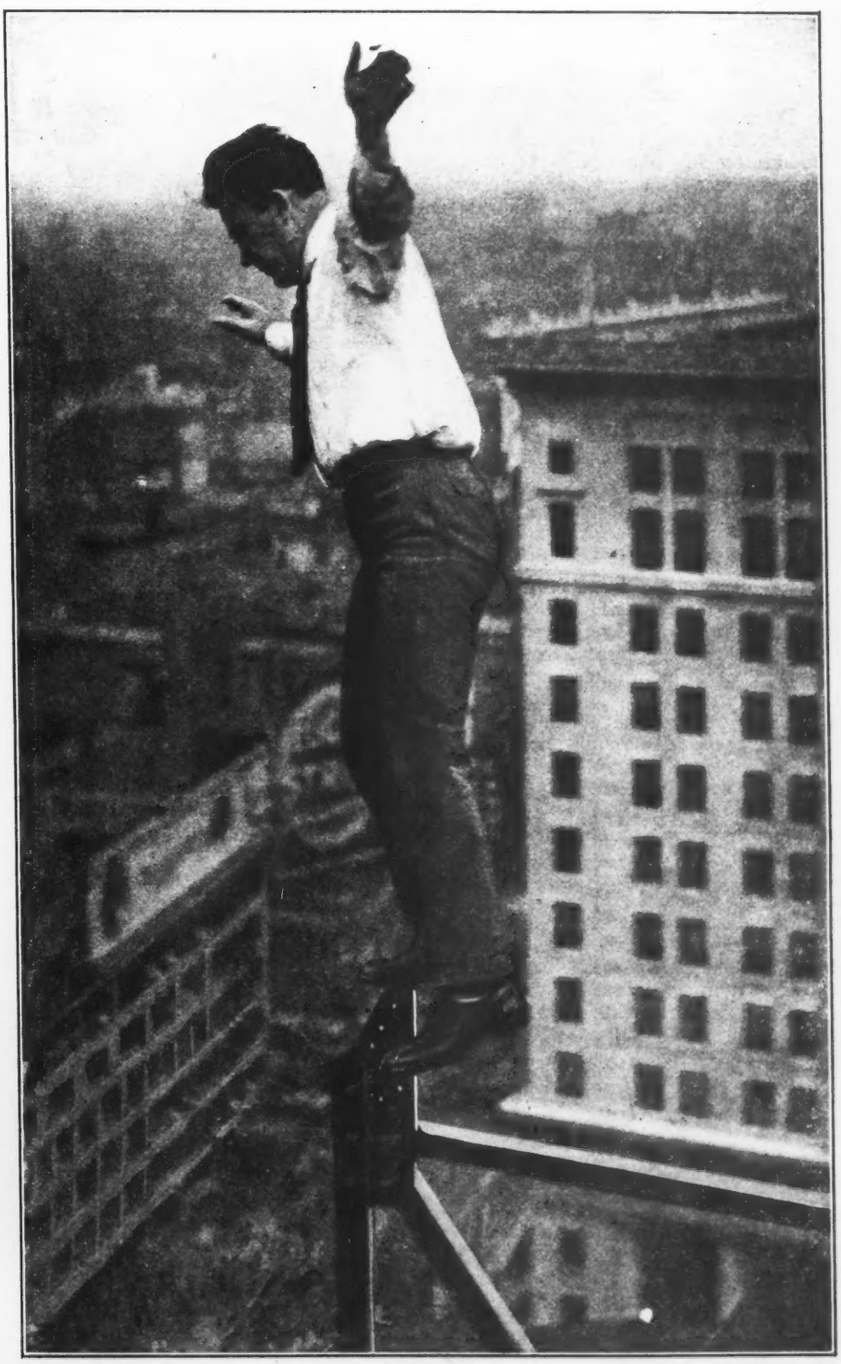
Most Persons Dread the Heights

It is easy to walk a plank laid across a muddy road. But if the plank is raised three feet from the ground, some persons will feel uneasiness in crossing it. If it is up 10 feet, most people will hesitate. If it is up 20 feet, only a very few will attempt to cross. And if it is up 30 or 40 feet, even though it is a foot wide, hardly one in a hundred of us would venture across without getting down on our hands and knees.

Most men and women cannot stand at the edge of a precipice or on an unrailed roof without becoming very uneasy. We fear falling so much that our legs begin to tremble and our bodies to sway. Unless we step back, we have difficulty in maintaining erect positions and are in grave danger of falling over the edge.

Most of us have this dread of heights to a striking degree. Usually it is possible to overcome the dread, except for those persons who suffer intensely from it.

The number of persons who cannot sit in the front row of a theater balcony seems



Does this picture of Capt. Charles Fitzgerald, famous Texas daredevil, make you dizzy? If so, you are subject to the most common fear—the dread of height. Fitzgerald is shown balancing himself on one foot 20 stories above Broadway, New York

almost incredible. And literally thousands find sitting in the front row of the gallery unendurable. I have patients who cannot stand close to the edge of a platform two or three steps high unless there is a railing.

This fear has often been attributed to the fact that when one looks down from a height, it is hard to fix the vision; and without a fixed point of vision we are likely to feel "teetery." There is some truth in this theory. But it is not the whole truth. Actually standing on a height is not necessary to produce uncomfortable feelings in many people. They need only imagine themselves standing at some elevated point to experience oppression at the pit of the stomach, a tightness around the chest, and curious feelings down the back.

Fear, the Child of Imagination

Most human beings experience the dread of heights if they merely look at a man standing at the edge of a precipitous rock or on the steel framework of a modern skyscraper. Capt. Charles H. Fitzgerald of Texas, who has gained fame as an aerialist, has made thousands of people shudder by his daredevil acts on lofty pinnacles over the streets of New York.

The same feeling manifests itself frequently at the very sight of a picture of an individual in such position. For example, the sight of a well known picture of a little boy looking down from a tenth-story window into the street makes many people feel very uncomfortable.

My investigations have convinced me that this fear of heights is a state of mind, not a state of body, though undoubtedly the lack of a fixed object close at hand emphasizes the fear and, in some people, initiates it.

Dread Brings on Disease

Next to the dread of heights, the most common fear is the dread of disease, especially the fear of serious developments from symptoms already noticed. People have a tendency to suggest to themselves that they may have something seriously the matter with them. The consequence is a state of discouragement that interferes with proper breathing and exercise as well as the appetite. This is followed inevitably by physical disturbance that further increases the feeling of invalidism. The result is a vicious circle in which the victim becomes convinced he is suffering from some serious ailment.

People subject to the dread of sickness are those who are cured of their ills by all sorts of remedies and modes of treatment that really have no physical efficacy. What really happens is that they are cured of the fears that made them ill.

When electricity was a nascent science, many such people were cured by absurd little Leyden jars that gave them a slight shock, or by electric machines that we would consider scarcely more than toys now. Some were cured by imitation electrical appliances that had not an ion of electricity in them. Twenty-five years ago a great many persons were cured by wearing electric belts or electric batteries supposed to give off currents that reawakened the vitality and revivified ailing tissues. Pictures showed electric radiations running off in every direction from the electrical appliances. But only in the pictures was there any active radiation of electricity.

Martha Miller and a man-eating lion she killed in the Belgian Congo, Africa. When she faced an audience of men and women in Newark, N. J., recently this fearless huntress fainted dead away!

People who suffer from fears find cures in each new digestive stimulant or nerve tonic, provided it is widely advertised. Fifty years ago various bitters were warranted to cure indigestion and everything else. Then came the sarsaparillas that cured people by the million. Next were the whisky tonics. Since the war there has appeared a new crop of remedies supposed to be wonderful extracts of plants.

These remedies do no good to the body, but they produce a curious effect on the mind, because of the suggestion that goes with them. This serves to counteract the fears and induces people to resume their normal life, food, and exercise. Anything that overcomes their dread will cure them.

Dirt Frightens another Large Group

In this age of sanitation, one of the most widespread of all fears is the dread of dirt. In many minds this is associated with the fear of microbes and of disease. The extent to which it grips some persons is almost unbelievable. I have known men and women who, in efforts to avoid dirt and microbes, washed their hands so frequently that they rubbed the skin sore. One patient of mine refused to touch the handle of the outside door of my office. The attendant always had to open the door for him. Usually when the patient came to see me, he would say, "Doctor, do not ask me to shake hands with you; you shake hands with so many people."

I have seen another of my patients standing outside of the storm door of a department store, with the temperature around zero, waiting for some one to come out so that she might slip in without touching the handle!

Such persons are nuisances to trolley car conductors because they always try to get on and off cars without touching the handles. They never will hang to straps.

Even Adults Dread the Dark

This dread of dirt is most common in women, yet it possesses many men as well—the men, for example, who persistently wear gloves all the year round.

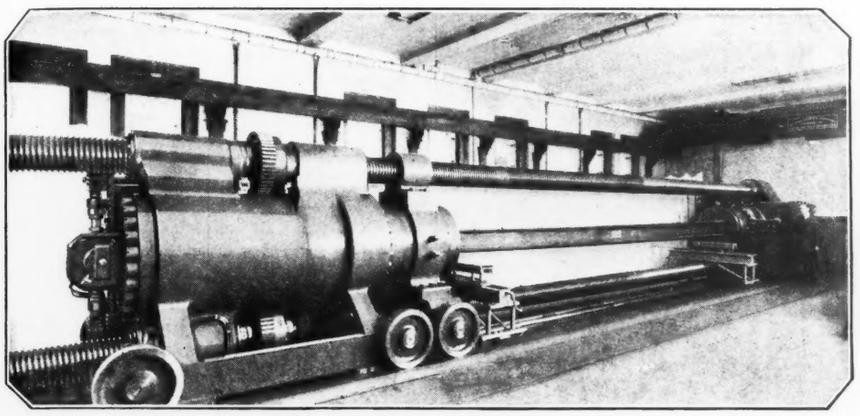
An extremely common dread is that of the dark. Many men would be quite uncomfortable sleeping alone in a house without a light. Yet most of them would find it hard to explain their feeling.

The dread of death is a universal fear. And so by convention we use the word death as little as possible. We employ such terms

(*Turn to page 99*)

Miss Miller, intrepid hunter of big game, who fainted from stage fright before an audience, is shown here with another of her kills, bagged during an adventurous expedition into African jungles with Dr. Carl E. Akeley (at the right)

Making Safe Props for Skyscrapers



A SINGLE column of the Woolworth Building in New York City supports a load of 4700 tons, or the weight of half a mile of coal cars loaded with 100 tons each. How did engineers know how much steel to put into this column so that it might safely support such a tremendous load?

The truth is, they did not know—exactly. They could make only a close estimate. For, when the Woolworth Building was erected, no testing machines in the world could approximate such a pressure. So the engineers tested smaller sample columns until they broke under the strain. In this way they deduced mathematically the approximate required size of the structural members that were to support the world's tallest skyscraper.

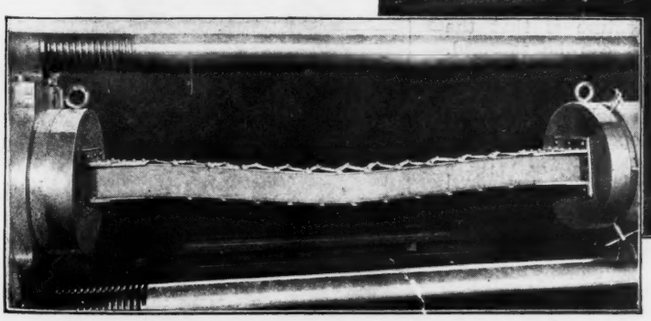
1200 Tons behind This Machine

Today a much closer approximation is possible, for the United States Bureau of Standards has installed in its laboratory a machine that can exert a crushing force of 1200 tons. With this machine it is possible to crumple up giant sample beams and girders as if they were paper. By actual pressure tests engineers are now able to make calculations that may produce even more startling steel structures than the remarkable skyscrapers that science has made possible previously.

In general appearance the new testing machine resembles one of the immense lathes used for turning steel. Upon a long bed are mounted a movable tailpiece, against which one end of the sample steel column is braced, and a headpiece that exerts the pressure at the other end of the column. A huge piston is brought to bear against the headpiece, exerting tremendous pressure through a fine film of oil. A proportionate amount of the pressure is transmitted through pipes filled with oil to a registering instrument. This device is so sensitive that it will register an added pressure of three or four pounds, while a million pounds is being exerted. If a load of 1200 tons is required to break a steel column, the column is considered strong enough to support a load of 300 tons safely.

Structural members may be divided into two classes: those that are subjected to a pull and those that are under compression. The former offer fewer difficulties in design, for if the engineer knows the amount of pull that the steel member must withstand and the strength of one square inch of the material, he need only divide the amount of the pull by the strength of the square inch to determine the required size of the member.

For compression members the calculation is more difficult. If a long piece of steel is compressed from both ends, the piece will bend and eventually break. One side will pull apart and the other crumple up. This bending and resulting weakness increase with the column's length and are determined by crushing in the new machine.



The arrow below points to one of the steel columns that support the tremendous load of the world's tallest skyscraper—the 785-foot Woolworth Building in New York. This one column alone holds up 4750 tons. To make sure that these supports will withstand such enormous pressures safely, Uncle Sam has perfected a testing machine, shown at left, which crumples steel girders as if they were paper

Courtesy Thompson Starrett Co.

How a steel girder bends and weakens under pressure of a thousand tons, as it is squeezed in the grip of the new testing machine, is shown at the left

Making Gavels Is His Hobby

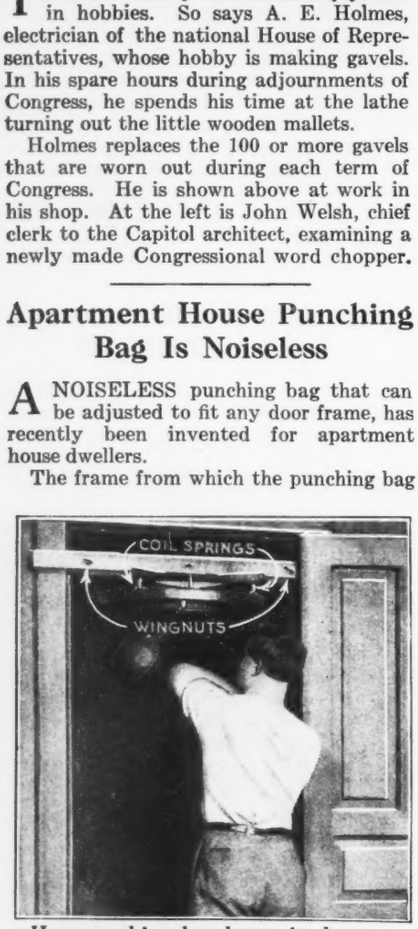
THERE'S money as well as enjoyment in hobbies. So says A. E. Holmes, electrician of the national House of Representatives, whose hobby is making gavels. In his spare hours during adjournments of Congress, he spends his time at the lathe turning out the little wooden mallets.

Holmes replaces the 100 or more gavels that are worn out during each term of Congress. He is shown above at work in his shop. At the left is John Welsh, chief clerk to the Capitol architect, examining a newly made Congressional word chopper.

Apartment House Punching Bag Is Noiseless

A NOISELESS punching bag that can be adjusted to fit any door frame, has recently been invented for apartment house dwellers.

The frame from which the punching bag



How punching bag hangs in doorway

hangs is suspended by coilsprings from a second frame attached to cross pieces. These cross arms can be clamped to the door frame at any desired height. The coiled springs take up vibration and thus deaden the noise.

Electric Hand Tool Holds Drill and Screwdriver

EQUIPPED with two spindles, one for boring guide holes and the other for driving screws, a new electrical screwdriving tool is especially useful in hanging doors, attaching hardware fittings and other similar work about the house.

When the guide hole has been drilled, the tool need only be turned about to drive the screw. Both the drill and the screwdriver spindles are started and stopped by pressure on a pushbutton switch in the aluminum motor casing. An ingenious driving clutch engages the bit only when downward pressure is applied to the tool. This feature insures safety in operation.

Weighs Less than Five Pounds

Another valuable feature is that the action of the spindles can be reversed, making it possible to remove screws cleanly as well as drive them.

The entire machine weighs less than five pounds, and may be operated easily with one hand. It is claimed it will drive a screw in one quarter of the time required by a hand brace.

An automatic burn-out protection device prevents injury to the motor through overloading either by accident or by carelessness.

Twine-Cutting Hook Opens Parcels Quickly

A HOOK-SHAPED twine cutter recently perfected by a manufacturer in Seattle, Wash., affords a quick means of opening parcels for inspection.

When the hook is passed over the twine, a sharp knife blade is brought against the cord, and with a few slashes the parcels can be quickly opened.

A Fifty-Mile Shadow

A SHADOW 50 miles long, thrown by Mount Rainier, recently fell upon the city of Tacoma, Wash. So distinct was the shadow that it eclipsed the evergreen scenery between the peak and observers in the city.

Because of atmospheric conditions, this phenomenon is rarely observed.

Heat-Driven Fan Cools Rooms in Summer

FOR homes not provided with electricity a new fan propelled by the heat from a kerosene flame, is said to give sufficient air circulation to cool a room during the hot summer months.

To operate the fan only a small quantity of kerosene is necessary—about as much as is used in an ordinary table lamp.

Within the upright tube that supports the fan is a simple hot air engine. The heat from the flame below works the piston in an eccentric cylinder, which in turn conveys two separate pistons alternately to the top. They turn the rotary shaft to which the fan blades are attached.

The scant heat from the kerosene flame is sufficient to turn the fan at about 500 revolutions a minute.

Kerosene lamp heat drives the fan

Why I Am an Inventor (Do I Hear a Laugh?)

By "Rube" Goldberg

"I Lampoon Inventions Because I Love 'em," Says Famous Cartoonist. His Great Ambition Is to Invent Something Useful

WITH me, science and invention are a serious business. I have made them a serious business because I recognize the fundamental human interest in such subjects.

Every man should have some knowledge of science and mechanics.

It is as helpful as a knowledge of law in business. To be able to turn a small screw on a typewriter may save many valuable minutes in a busy office. Ability to remedy a simple matter of ventilation may speed up the work of an establishment. Then the knowledge of some scientific principle may enable a man to put a new and useful product on the market—may make him rich.

He's a Mechanic

My knowledge of science and mechanics is largely responsible for my progress as a cartoonist. When I was studying mining engineering at the University of California, I took up analytical mechanics. I was introduced to a machine, invented by one of the professors, used to determine the weight of the earth.

This machine amused me, as it did every other student in the class, and I began to draw pictures of machines of my own that I thought were useless. These fantastic drawings were the beginnings of my career as a cartoonist.

Practically every American man likes to work with tools. I have this leaning toward mechanics and I have taken it into my work. The response has surprised me. It has proved to me that we are living in an age of science and mechanism.

"A lot of wasted energy could be used by attaching coffee grinders to turnstiles." A typical Goldberg cartoon-invention

One of my useless inventions was a mechanical music turner. Every bashful man who has had to stand up before visitors and turn music for his wife or sweetheart will sympathize with my attempt to do away with this embarrassing nuisance. My idea was to have a foot pedal connecting with an arm for turning the pages. Of course it has not been put on the market. But may be, some time, it will be.

The average man dislikes to carry an umbrella. Many throw them away as soon as it stops raining. Once I conceived the idea of inventing a folding umbrella that could be put in the pocket when not in use. It has never been perfected, but I still think it is a good idea.

Do I hear a loud laugh?

I have taken my place also among the thousands of Americans who have dreamed of a non-skid device for automobiles. My idea was to have a fifth wheel equipped with chains that could be dropped to the pavement beneath the car. I was surprised to find that two others had had the same idea before me.

The thousands of men working on inventions in the country today get a lot of enjoyment seeing fantastic drawings of mechanical things. Why? Because they see the humorous side of many of their own ideas, and I'm not convinced that I do not offer usable ideas now and then.

Even the man who has not tried his hand at invention generally has a home workshop. What is the first thing he shows a visitor? Usually it is some little contrivance he has rigged up. He is proud of it because it shows he has some knowledge of mechanics. And he is always ready to laugh at one of my crazy mechanical cartoons.

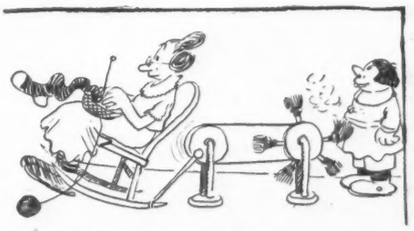
When a child breaks a toy, it is up to the father to fix it, or lose his reputation. A cartoon on the subject is good for a laugh in nearly every American home.

And what man hasn't had the idea of inventing something to automatically stoke, shake, and clean his furnace? Some elaborate contrivance for doing so, pictured in a cartoon, is sure to tickle him. Usually he is sport enough to laugh at his pet theories.

Crazy as some of my mechanical cartoons are, most of them are mechanically possible. The same is true of nearly every invention.

I still have hopes of inventing something useful. Perhaps I may yet come across the big idea in working out some of my foolish cartoons. The field is wide and strange things happen.

Article published by arrangement with McNaught Syndicate, Inc.



"Grandma's rocking-chair could run a machine to dust off little Aleck," says Goldberg. He says it's mechanically possible

Goldberg, sketching one of his mechanical "nut" cartoons

A Man's Cartoonist

FROM time to time readers have written us complaining that "Rube" Goldberg lampooned invention. Finally, the other day, we went to the famous newspaper cartoonist whose caricatures reach thousands of Americans daily and said: "Well, what about it?" Here is his answer:

"Sure, I lampoon 'em! But I lampoon 'em because I love 'em—because I understand 'em. I lampoon them with the sympathetic understanding of a father for his son. By nature I am an inventor. We all want to invent something useful. The thousands of men working on inventions today get a lot of enjoyment seeing fantastic drawings of mechanical things. Why? Because they see the humorous side of their own ideas. And I'm not convinced that I do not offer usable ideas now and then."

With Goldberg, science and invention are a serious business. He recognizes the fundamental human interest in mechanical subjects. Upon the interest of American men in science and invention he has built his success.

HOW SCIENCE TRACES OU

The Wonder Story of Man's Descent from Little, Catlike Creatures that Skipped about in Trees Millions of Years Ago

Fourth article in the series,

"The Story of Man and His World"

By E. E. Free, Ph.D.
Fellow American Association for the Advancement of Science
and
William K. Gregory, Ph.D.
Curator of Comparative Anatomy, American Museum of Natural History

MAN and monkey are distant cousins. Man and the gorilla are first cousins. Both of them developed out of common ancestors millions of years ago.

In last month's article we told how worms, fish, and reptiles, striving through millions of years, helped to invent and create the complex machinery of the human body; how the record of these inventions is still preserved with us. It was the story of creation, leading up through the ages to man's first animal ancestors.

More than one million years ago there were already men in the world. It was about that long ago that the snows and frost of the great Ice Age crept down over the northern continents and buried them under hundreds of feet of perpetual ice. New York and Wisconsin, England and Scandinavia, were like the Greenland and the North Pole of today.

Yet *underneath* the sand and gravel scraped up by this great ice sheet and left behind it when it melted, English scientists have found the signs of man—camp grounds and fireplaces and rude stone tools that prove unquestionably that men were there before the ice.

Preglacial Men

Probably these men were rather brutish, much more so than modern men. But they had begun, we cannot doubt, to have a human brain.

The fact that our familiar traditions of man's creation cover a time so much shorter than this, is due to a very natural mistake. We inherit these traditions, through Greek or Jewish intermediaries, from the men of ancient Babylon, probably the first of all races to develop what we may call a civilization and certainly the first to attempt the formulation of a science and history of the world. These ancient historians followed, of course, their own racial traditions. They confused the history of their own escape from savagery with the history of man. "When *we* began," they said to themselves, "there began all that is worth remembering in mankind."

And so they set down for the origin of the world what they remembered of the origin of the fertile plain on which they lived. All lands had been rescued, they thought, from the universal waters just as the swamps of Babylonia had been rescued when they were diked and drained. The human race began, they believed, in the pleasant garden lands to the eastward whence, they remembered dimly, they themselves had come a millennium or two before.

This is why we have been taught that man is a creature of a scant six or seven millenniums. It is a mistake inherited from the self-centered sages of forgotten Babylon. It is true enough, of course, for our civilization. It is not in the least true for man.

The development of man began, as we have seen in previous chapters, much farther back even than the English campers and fire-users of a million years ago. Man was not created suddenly out of nothing either in Eden or elsewhere nor on any definite date. Man is the culmination of the billion-year progress of evolving Life. The body that he owns and uses was invented for him by uncounted millions of his animal ancestors.

Animal Shows First Human Tendencies

But when did this body begin to be perceptibly human? When did the distinctive, manlike inventions begin to appear clearly in the forms of lower animals?

Even for this we must go back much farther than a million years. We must go back, perhaps, 70 or 80 million years.

Back in those times the country around the North Pole was warm. It was a pleasant land of flowers and grass carpets and thick forests of trees. Many animals lived in it, and among them, skipping about in the tree branches, were some little, catlike, big-eyed creatures like those we now call lemurs. They were remarkable chiefly because they had the beginnings of a hand. They were, perceptibly and assuredly, the ancestors of man.

© Amer. Museum of Natural History

In the American Museum of Natural History in New York City there are stored away several priceless fossil skeletons that belonged to some of these ancient lemurs. They were found in Wyoming. They

OUR MONKEY ANCESTRY

represent, probably, one of the earliest cousins of the human stem; not a direct ancestor of either man or the apes, but an adventurous side branch of the family that migrated down out of the polar regions into North America perhaps 50 or 60 million years ago.

Migrations of Man's Ancestors

Left behind in the pleasant polar forests were many other branches of the family. These branches kept on developing. Some of them migrated from time to time into America and into Asia. A few of them reached the islands of the western Pacific, especially Madagascar, and they liked these islands so well that they stayed there and did not change very much. They are there yet. In the bodies of the living lemurs of these islands we can confirm today what we learn from the fossil bones of their ancestors. We can see something of what these earliest human predecessors were like.

Many of the polar lemurs came down, we have said, into Asia. Perhaps the cold around the North Pole was already increasing and drove them out. Anyway, they liked Central Asia and settled in it. For some reason it proved to be a favorable place for evolution. The Asian lemurs changed rapidly. They improved their bodies, especially their hands. They still lived in the trees as they had always done, and they ate insects and fruits. Good hands helped them to hold on to branches and to pick luscious grubs off the leaves. Presently the little lemurs had become monkeys.

Here again we are helped to reconstruct the history of evolution by what biologists call "living fossils"—creatures that have lived on with little change so that we can catch and examine them today. Some of the lemur-monkeys migrated out of Asia just as their ancestors had migrated into it from the polar regions long before. They spread down into India and Africa and the islands of the Pacific. Like the lemurs in Madagascar, some of them lived on. They are the monkeys of the Old World forests. They are probably a good deal like their ancient Central Asian ancestors from which we ourselves have sprung.

Asia the Cradle of Humanity

Asia was still, somehow, a stimulus to evolution. Not all the lemur-monkeys had migrated out of it, and those that stayed kept on changing and improving. Gradually they grew larger and stronger in body. Tree-living had already taught them to hold themselves erect and presently some of them climbed down out of the trees and learned to walk, rather awkwardly, on the ground. They had become apes.

Of some of these apes of Central Asia, half tree-livers, half walkers on the ground, we have actual fossil bones. Several species of them have been found in the rocks of northern India. A single tooth of a creature apparently much like the Asian ones was found recently in Nebraska. And, as before, we have the living fossils too. Some of the apes wandered out into southern Asia and into Africa. They became the chimpanzees and the gorillas, the latter undoubtedly the nearest living relatives of man.

In the Asian homeland of our family, evolution still went on. The apes used the trees less and less; perhaps the climate was changing so that the forests were sparser and there were fewer trees to use.

Brains of Apes Learn Cunning

Anyway, the apes walked more often and better. Their brains, already trained for accuracy and quickness by their life in the trees, learned cunning and foresight so that they might escape the stronger animals on the ground.

In 1891 the Dutch archeologist DuBois found two fossil bones and three teeth in some river gravels in the island of Java. One of the bones was a piece of a skull. It and the teeth are partly apelike, partly human. The other bone, which was that of the thigh, shows that the creature walked erect. Under his scientific name of *Pithecanthropus erectus*, "the man-ape who walked erect," this creature occupies an extraordinarily important place in our knowledge of the history of man. The size of his brain is intermediate between that of the living apes and of man. His leg bone is clearly of human type. There is no doubt that when he was alive he was a creature much like the long sought "missing link" between man and the apes.

The theory of human evolution does not depend, however, upon this discovery. It would be quite absurd to base a theory so far-reaching and important upon nothing more substantial than five broken bits of bone, even though one of them be as eloquent as the skull.

This scene, representing the prehistoric Neanderthal race of cavemen that lived in Europe the latter part of the glacial epoch, is based on scientific evidence in the form of fossil skeletons, flint implements, and the bones of extinct animals found with them

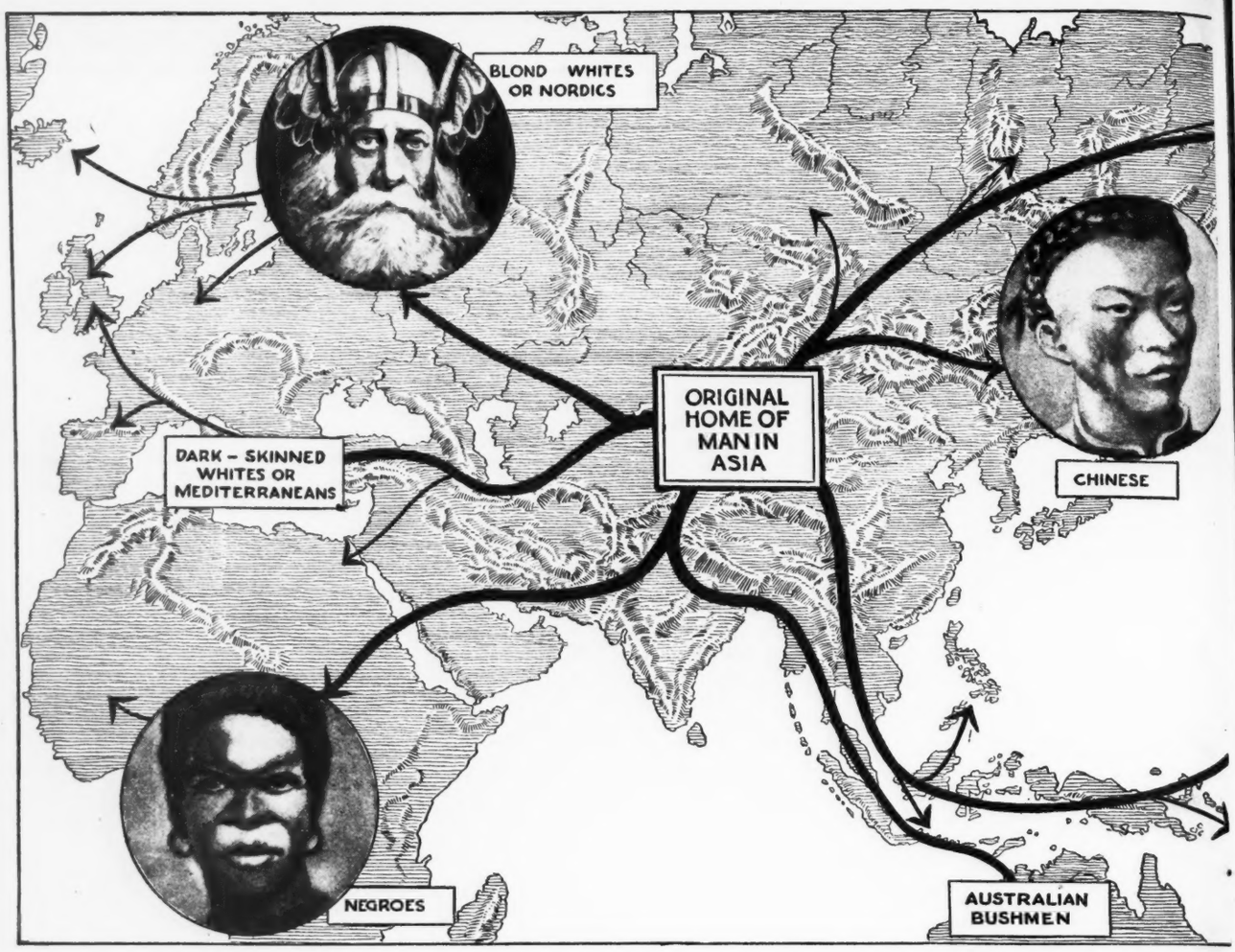
Man Proves His Origin

The real evidence is much more impressive than this, much more certain. It is to be found most convincingly in the human body itself. The complete and detailed similarity in bodily structure between man and the apes; the presence in man's body of scores of vestige organs, like the appendix; the demonstrated kinship between man and the living apes in the chemical composition of their blood; facts like these have convinced the scientists that human evolution is a sure and proven truth.

But the recovered bones of "the man-ape who walked erect," do help to confirm what we have learned elsewhere. Long before DuBois' discovery, scientists were sure that man had grown out of some kind of walking ape. The bones proved what we already knew. They showed us, unmistakably, that the walking ape we believed in had really lived.

But Pithecanthropus was hardly a man; he was merely in process of becoming one. Who took the next and final step?

We are still not entirely sure. The earliest recovered traces of man are those



English ones that we mentioned in the opening paragraphs of this chapter. But no one believes that man originated in England. It is probable that he began, as did all his monkey and apelike predecessors, in the highlands of Central Asia.

The individual Pithecanthropus whose bones we have recovered was presumably a wanderer outward from this region. Some of his cousins stayed at home and to them there came the same improving and relatively rapid development that the Asian surroundings had forced already upon the lemur and the monkey and the ape. Their brains grew and improved; they began the use of tools; fire was conquered and put to work.

The Asian origin of creatures like Pithecanthropus is to be dated perhaps three or four million years ago. By another two or three million years—perhaps from one to two million years ago—there must have been living somewhere in Central Asia creatures who were essentially human.

Survivors of the Ice Age

It was some of these early humans, outward wanderers like the Madagascar lemurs and the monkeys and Pithecanthropus, who got as far as England even before the Ice Age and who left there the camps and tools and fireplaces that modern scientists have found. Probably these wanderers were always few and transient. The Ice Age was soon upon them and they perished or fled.

But the Ice Age, when it came, was not continuous. It consisted of four separate periods of cold and ice. Between these were three warmer periods; scores of thousands of years when the ice melted away and when plants and animals characteristic of the tropics lived well up toward the north of Europe. It is in gravels deposited during the first one of these warm interglacial periods that we find the earliest undoubted bones of man.

In 1907 there was found in the valley of the Elenz River near Heidelberg, Germany, 80 feet below the surface of the soil, the jawbone of a man. This is the celebrated "Heidelberg man." The bone is unquestionably human, but it is not modern. The chin is small and receding, the jaw is wide and massive, the muscles that once were attached to it were evidently very broad and powerful. Like Pithecanthropus, this was a creature on the way from ape to man, but he was a long way nearer man than was Pithecanthropus.

Skull Fragments Found in England

There has been a similar find in England. At Piltdown, near the southeastern corner of the island, there were found, between 1911 and 1917, several fragments of a human skull, some teeth and part of a jawbone. The material is meager and imperfect. Authorities differ as to just how the creature from whom these fragments came ought to be reconstructed. But few doubt that he was human or nearly so; far closer to man than to the apes.

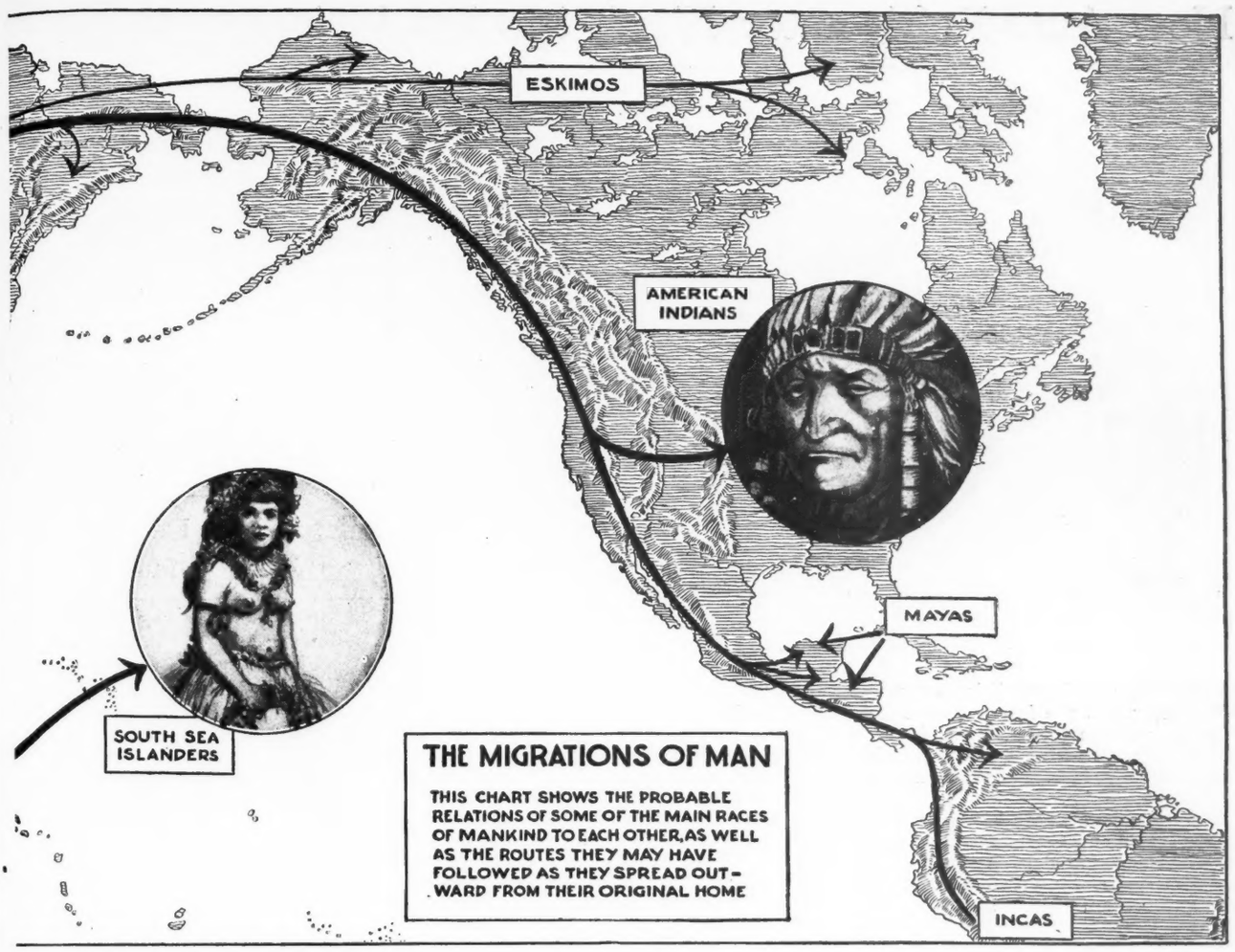
Within the past two years there has been a third find in Africa. In a cave in Rhodesia the bones of still another very primitive man were found. It is possible that these may be fairly recent in years. But in type, in the character of creature represented, they are very ancient. Their owners may have been more of our "living fossils"—early types of men who lived for a while in the wilds of Africa, just as the lemurs and the apes have done.

These three, the men of Heidelberg, of Piltdown, and of Rhodesia, are the principal types of very ancient men whose actual bones we have found. All of them were probably wanderers, parts of the far-flung line of explorers and adventurers who had crept slowly over the world out of the Asian home of their race, just as so many of their ancestors—monkey and ape and Pithecanthropus—had done before them. What these bones seem to mean is this: that during the long millenniums of the glacial period, while the ice sheets were alternately advancing and retreating over the face of Europe, men were developing in Asia, the continent where we have not yet dug very much, and from which we have recovered no remains. From these Asian fastnesses, low types of men were seeping out over the world. Men penetrated into Africa. Other men reached India and the islands of the Pacific Ocean. Still others trickled into Europe and hung about the edges of the glaciers as they melted or advanced.

When the Heidelberg Man Died

There were, you remember, four separate periods of advance of the ice. Between them the climate was warm. During the first of these warm periods the Heidelberg man died and left his bones for us. Then the ice of the second cold period came on and so far as we know the men of the Heidelberg race went out before it, never to return.

Presently the ice retreated and advanced and then retreated again. And during the warm period that followed, the third and


ESKIMOS
AMERICAN INDIANS
MAYAS
INCAS
SOUTH SEA ISLANDERS
THE MIGRATIONS OF MAN
THIS CHART SHOWS THE PROBABLE RELATIONS OF SOME OF THE MAIN RACES OF MANKIND TO EACH OTHER, AS WELL AS THE ROUTES THEY MAY HAVE FOLLOWED AS THEY SPREAD OUTWARD FROM THEIR ORIGINAL HOME

last of the interglacial periods, many men must have come into Europe. In the sands laid down at this time we begin to find numerous flinty stones, rudely chipped and shaped by hand, stones that were, undoubtedly, the tools and weapons of some very primitive kind of man. The beginning of this last warm period between the ice ages cannot have been less than 125,000 years ago, and by that time Europe seems to have been well sprinkled with these savage, stone-using men.

These newer men were not of the race of Heidelberg. They were much higher in the human scale, much nearer to the modern type. They belonged to the race now famous as the Neanderthal, a name derived from that of the little valley in Germany in which some of the first of their bones were found in 1856.

What Neanderthal Man Was Like

These Neanderthal men were shorter than modern men. Their arms and legs were short. The trunk of the body also was short and thick, as though to give great strength. The face was broad and somewhat apelike, with a low retreating forehead and very little chin. It is probable that these men did not hold their heads quite erect, but bent forward a little, looking out warily upon their world from eyes deep set under lowered and shaggy brows. It is clear that they were much more animal-like than modern men, but it is just as clear that they *were* men.

Waves of these Neanderthal men seem to have rolled into Europe from Asia almost as soon as the ice was gone. They held it, undisputed, for more than 100,000 years; for more than 50 times as long as the time that has passed since the days of Christ!

Even the fourth and final return of the ice did not displace them. By about 70,000 years ago the last of the warm interglacial periods was over and the ice was beginning to come back. By about 50,000 years ago Europe was buried again almost as far south as the Alps. But the Neanderthal men stayed on. They hung about the margins of the ice sheet. We find their stone tools and their bones among the sand and gravel that the ice laid down.

Our Forefathers Invade Europe

They yielded, finally, not to nature but to man. About 20,000 years ago, after the ice had begun to retreat for the last time, but before it had entirely gone, there came into Europe another kind of men. These newcomers were men like ourselves. They came, apparently, in several waves, probably at different times, perhaps by different routes. We believe that they came from the same Asian homeland out of which all the earlier migrations had poured. There were different races among them. A few were like negroes; some were round headed, probably dark white or yellowish brown; some were long-headed whites, much like the modern blond whites or Nordics. All of them were hunters. They seem to have found most of their food in the herds of wild horses, reindeer, and other animals that then ran wild all over Europe.

These men fought the Neanderthals and vanquished them. The 100,000 years of low-browed cavemen were over. From now on, Europe was to be the home of men as large brained and as human as ourselves.

For these hunters who took Europe away from the Neanderthals those 15 or 20 millenniums ago were artists as well as warriors. They could draw and paint and carve figures out of ivory or soft stone. All over France and Spain they left vivid and lifelike figures scratched on the rock or painted on the walls of dry and sheltered caves, where we can see them still. In those days the great hairy mammoth was still alive and these men saw and hunted him. They painted his likeness in scores of places in the caves; they scratched his outline on many bits of bone. And so, though this great beast has been extinct for thousands of years, we have pictures of him almost as good as though he were still here to be photographed.

One race of these artist-hunters was the famous Cro-Magnons, whose skeletons we have found. They were tall, well-formed, large brained; quite the equal of ourselves in the size, and apparently in the quality, of their brains.

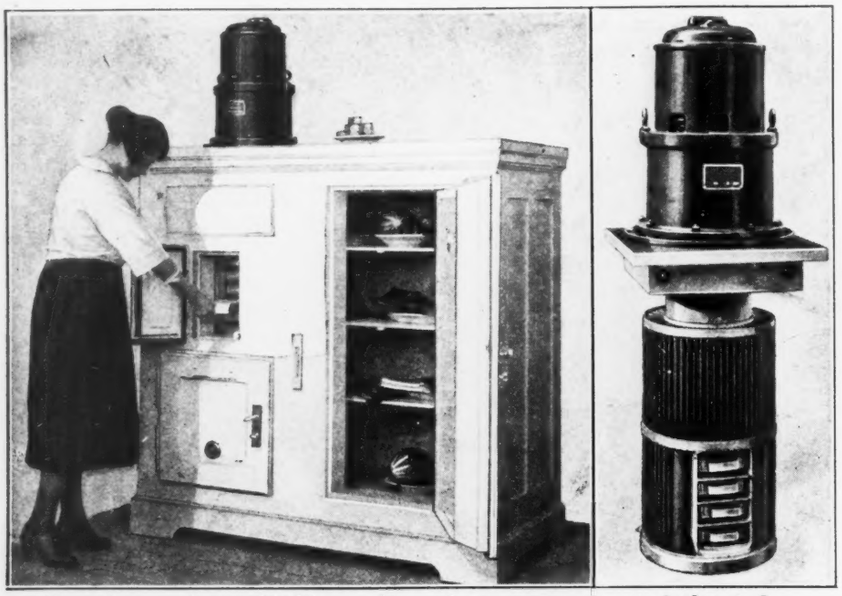
After the Ice Receded

When these men first arrived in Europe, the ice was still there, but it was going. By about 12,000 or 15,000 years ago it had altogether gone. With it went the herds of reindeer and the small wild horse. The food supply of the hunters vanished.

And at the same time they faced disaster from without. New waves of men were coming in from Asia. These new men were not solitary hunters and cave dwellers. They lived in tribes and communities. They built villages. They knew something of agriculture, enough to sow and harvest wheat and perhaps one or two

(*Turn to page 98*)

New Auto-Refrigerator Needs No Ice



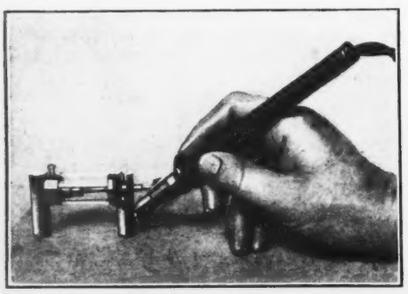
How the new electrically driven refrigerating apparatus is attached to icebox

RELIEF for the housewife's summertime worries that the iceman may fail to show up and the food will spoil is promised through the perfection of an electrical auto-refrigerator in which liquid chemical is used in place of ice.

The new apparatus consists of a cylindrical tube containing the refrigerating apparatus and surmounted by a small electric motor connected by a two-pin wall plug with a socket in the kitchen.

The motor operates a pump that compresses fluid methylchlorid and forces it through a nozzle into a lower compartment. There, under diminished pressure, the liquid chemical evaporates and quickly cools, producing a refrigerating effect.

The vaporized methylene then rises to the upper chamber, where it is again condensed and forced back to the same vaporization. The apparatus can be fitted into an ordinary refrigerator. An added feature is a compartment in which bowls filled with water or mixtures for ice cream can be placed. After a short time the water or ice cream mixture is frozen.



Smallest Soldering Iron for Radio Work

AN ELECTRIC soldering iron that is only as large as a fountain pen has recently been perfected by a New York concern for use in radio and other work where small amounts of solder are required in difficult corners.

The instrument has a platinum heating unit. Soft wire solder is used when operating on small work. The tool is said to be the smallest soldering iron ever made.

Magnetized Screwdriver Is Useful for Car Owner

TO RECOVER bolts, nuts, screws, or other metal objects that drop into inaccessible places, the automobile owner will find a screwdriver that is magnetized a great convenience.

All that is necessary to magnetize the tool is to hold it close to a dynamo for a few minutes, until it has become charged.

Novel All-Year Hat Has Interchangeable Crowns

A SERVICEABLE all-year hat for men, recently invented in England, can be converted from a winter hat to a summer one, simply by interchanging crowns and brim covers.

The hat is made of a stiffened material serving as a base over which various kinds of covers may be drawn. A few seconds only is required to change from a felt to a waterproof or straw hat.

© Pictorial Press

Changing his hat from winter to summer style

Shaving Brush and Rubber Massage Combined

SERVING the double purpose of lathering and massaging the face, a novel combination shaving brush has recently been placed on the market by a Pittsburgh concern.

The combination brush

The lather brush is slidably mounted in the handle so that it can be drawn back, simply by pulling a small pin. As the lather brush slides into the handle, a small mound of lather remains in the center for the rubber massage.

Safety Spurs Keep Ladder from Slipping

Two spur brackets hold the ladder

TO PREVENT some of the thousands of accidents caused annually by the slipping and overturning of ladders, ingenious safety spurs recently have been invented.

They consist of two pointed, bent rods, clamped to the top of the ladder standards.

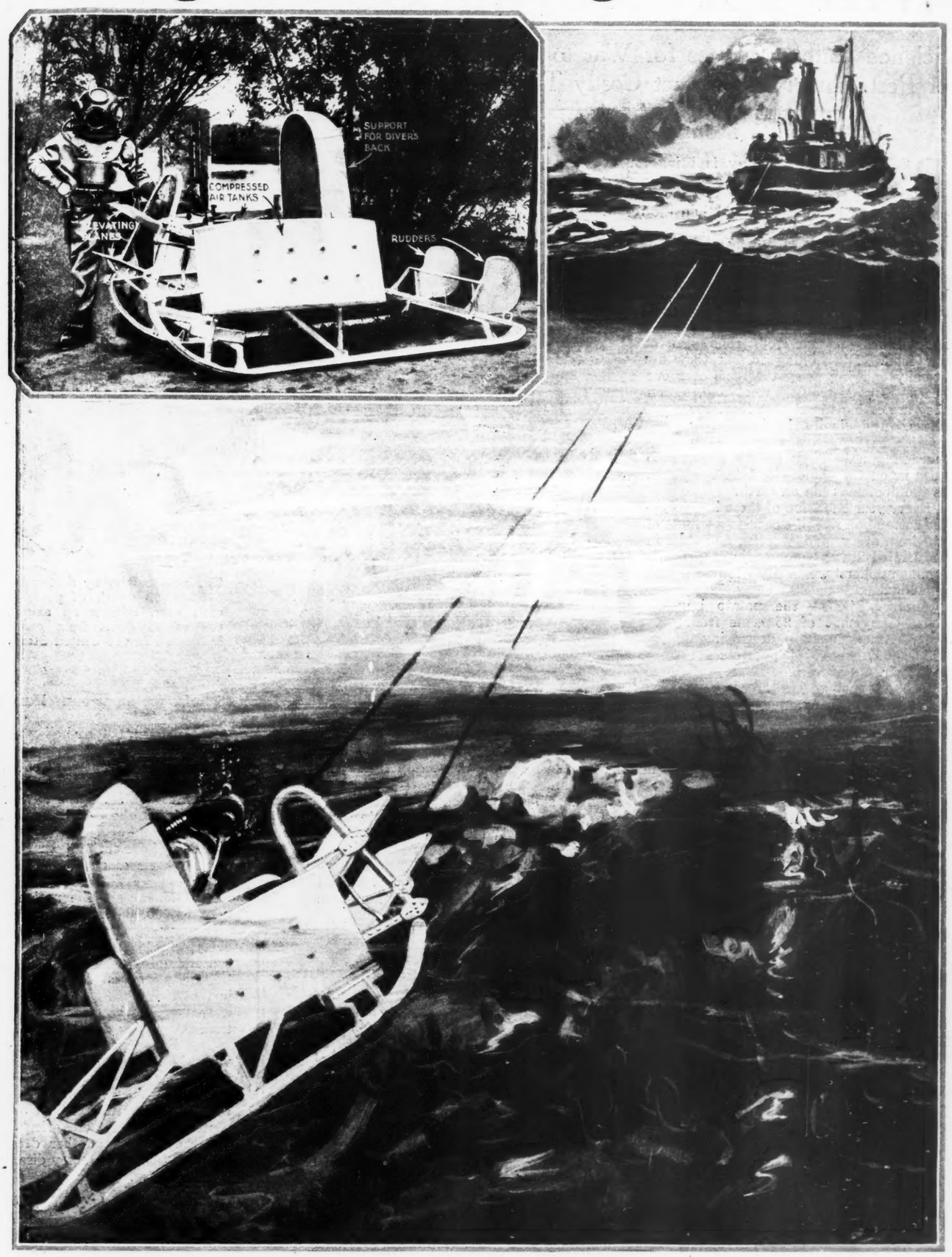
By resting the points against the building or wall on which he is working, the painter or carpenter is assured of a support that will not slip. Even if the footing gives way, the ladder still will remain fastened to the wall.

The long arms of the spurs serve as useful brackets to hold paint cans or tools. They also hold the ladder out from the building, giving ready access to the wall.

Tons of Powder for Noses

AMERICAN women used up twenty million pounds of face powder last year, the U. S. Department of Agriculture reports. This was about eight ounces for the average woman.

Diving Sled to Salvage Treasures



GERMANY is preparing to use a novel "diving sled," designed to coast along the ocean floor at great depths, in attempts to salvage some of the millions in treasure sunk by her submarines during the war. Pulled by cables from a towboat, the strange steel scooter is guided by a deep-sea diver, who sits in the cockpit, supported by a hooded back rest, and controls the rudders and planes.

The controls consist of two rudders at the tail that steer the sled laterally, and two finlike elevating planes at the bow, by which obstructions can be hurdled.

The body of the sled incloses compressed air tanks to supply the diver with air, as shown in the inset above, thus eliminating the usual airlines from the surface. The equipment also includes a lock containing the diver's apparatus and food. Hermetically sealed incandescent lamps supply the illumination for the search.

It is claimed that the sled can be used at depths of 250 feet.

Will Ravenous Insect Hosts

Science Gathers Forces for War to the Death on Invading Armies of Pests that Now Collect Costly Tribute in Food and Clothing

By Harry A. Mount

BEFORE our eyes today is being fought what scientists say is the most devastating war in the world's history—a war more destructive to life and property than the recent great conflict of nations.

It is the silent war between man and insects. From the four corners of the earth, vast invading hordes of bugs are slowly, surely, forcing their way into man's domain. They are ravaging our fields, destroying our crops, robbing us of our food. By ruining forests they are literally gnawing away the roofs over our heads. By destroying wool and cotton they are eating the clothes from our backs. And, finally, by inoculating us with disease germs, they are even murdering us. They are threatening to push us off the planet—to take our places as the dominant life on earth.

Every year one tribe of these invaders—the cotton boll weevil—collects a tribute of $10 from every man, woman, and child in the United States—money that represents a billion dollars' worth of cotton destroyed annually.

Another tribe—the potato bug—collects payment of 25 cents from every American, by destroying $25,000,000 worth of potatoes each year.

The potato bug, by destroying $25,000,000 worth of potatoes each year, collects an annual toll of 25 cents from every individual in the United States

The advancing foes are innumerable, untiring, merciless. Not one of us can escape the tax they impose. Still the insects are not satisfied. They want the whole world.

And now science has declared war in defense of mankind. It will be a war to the finish. Which will survive—man or insect?

The formal declaration of war was made recently by Dr. L. O. Howard, Uncle Sam's chief entomologist, who is leading an army of government scientists sent into the field to drive back the bug invaders. Sounding the warning that insects threaten to drive man from his habitations on earth, he called on the nation's young men to enlist in a world-wide campaign of self defense.

"Man still is the dominant type on this terrestrial body," said Doctor Howard. "He has overcome most opposing animate forces. He has subdued or turned to his own use nearly all living creatures. Yet there still remain the bacteria and the protozoa that carry disease, and the enormous force of injurious insects that attack him at every point and that constitute today his greatest rival for the control of nature.

"By the introduction of sanitation, man has made notable progress in overcoming disease-carrying bacteria and protozoa. But the fight with the insects has been going decidedly against him. These enemies threaten his life daily. Rapidity of multiplication, power of concealment and many other factors contribute to their persistence. In many ways they are better fitted for life on earth than is man.

"Insects are the only creatures capable of making a cooperative attack against us. We have ignored them in the past because of their smallness, not realizing that was one of their very points of strength. Before we can call this earth ours, we shall have to bring under subjection this insect horde, and that will require the highest scientific skill at our command."

Convincing proofs to substantiate these fears can be seen on every hand. While some of the most destructive insects are strangers to the average man, other dangerous enemies—the fly, the mosquito, and the cockroach—are familiar in hundreds of thousands of households in the United States.

> "BEFORE we can call this earth ours, we shall have to bring under subjection this insect horde; and that will require the highest scientific skill at our command."—Dr. L. O. HOWARD, *Chief Entomologist, United States Department of Agriculture, leader in insect war.*

Almost every one is familiar with modern campaigns against the disease spreading housefly. Vast sums of money are spent by householders each year in buying screens and poisons to combat the fly. Yet flies are as numerous as ever.

The fever carrying mosquito, against which man has battled for years, shows no signs of defeat. In fact, last year clouds of mosquitos reappeared in certain localities where they apparently had been wiped out.

Insect victories are numerous. Human victories few.

A few years ago the cotton boll weevil invaded our Southern border. A desperate fight for control of the cotton fields followed. Foot by foot, with poison and gas, our scientists have contested the advance of the weevil, and yet the pest has moved as steadily onward, and at last has reached the extreme limits of our cotton belt. Some scientists now despair of ever conquering him.

That defeat alone costs the nation at least $1,000,000,000 a year, and you pay part of that huge sum every time you buy any article containing cotton.

Other pests are just as threatening, although they have not yet caused such widespread destruction.

The European corn borer invaded New England several years ago. Now this pest has reached the edge of our great midwestern corn belt. Scientists of the United States Department of Agriculture say that within another decade the corn borer may carry disaster into that rich territory.

The potato bug likewise has defeated the best efforts of science against it, adding $25,000,000 a year to the cost of this important food crop.

The bean beetle, a visitor from Mexico, is hampering the important bean growing industry of the South. And this menace is working northward and westward at the rate of 150 miles a year. That means that the bean beetle is conquering the United States at the rate of half a tier of states each season!

Push Man off This Planet?

It is a far journey from Cochin China to Texas, yet the duckbilled blue beetle, which is now destroying the sweet potato crop of the South, successfully made the trip. The invasion of this pest affords a striking example of how insects travel. They take advantage of every new method of transportation devised by man. By railroads, steamship lines, freight cars, motor trucks, wagons—they advance into every corner of our rich country.

The sweet potato beetle stealthily entered the United States through one of the southern ports. Before its presence was detected, it had spread through Texas, Louisiana, and Florida. Sweet potato crops, ruined by these beetles, have been abandoned in the ground by many farmers. In some cases the farmer has divided his crop, taking half for himself and surrendering the other half to the beetle robbers. The damage caused by this pest now runs into the millions yearly and there is danger that the South may have to abandon its sweet potato altogether.

America indeed is a land of opportunity for destructive insects! Bugs that cause small damage in their native haunts become marauders on a large scale as soon as they reach the rich fields of America. Once in the cotton fields of the South the boll weevil rapidly developed and multiplied on the rich food of the cotton bud until now it devours half the annual crop.

Strangely enough, the conditions of civilization sometimes are unfavorable to the "home bugs." Take the grasshopper, for example. Some species of this pest are native to almost every section of the world. Once the grasshopper ruled as king of the insect hosts. Now he has been deposed by hundreds of claimants to his throne. One of these—the Japanese beetle, which, like the European corn borer, gained a foothold in the East—today is moving towards the Middle West. The codling moth, the brown tail moth, and the gypsy moth, attack and destroy millions of dollars' worth of fruit and fruit trees yearly. The Western pine beetle and other insect species have killed millions of forest, fruit, and shade trees.

The cotton boll weevil literally eats the shirts off our backs. This arch enemy of man annually destroys $1,000,000,000 worth of cotton, collecting a tribute of $10 from every American

In all, 716 different species of injurious insects are listed among the invaders that the United States Bureau of Entomology is trying to combat with an "army" that numbers less than one man to each species! Well, what are we going to do about it?

The answer of science is—Fight.

The government's plan of campaign is to meet the bug on its own ground—in the field. Whenever a serious outbreak of a new insect pest is discovered, a force of scientists is sent to the spot. The insects' habits are studied at close range and then the work of extermination is begun. The scientists are too few in number to do all the fighting themselves. As a rule, the best they can do is to show the farmer how to combat the pest.

The difficulty then is to get the farmer to carry on the work. Sometimes the farmer finds it cheaper to abandon his crop than fight. In that case the insect is left in undisputed possession of the field and, ultimately, *the whole district*.

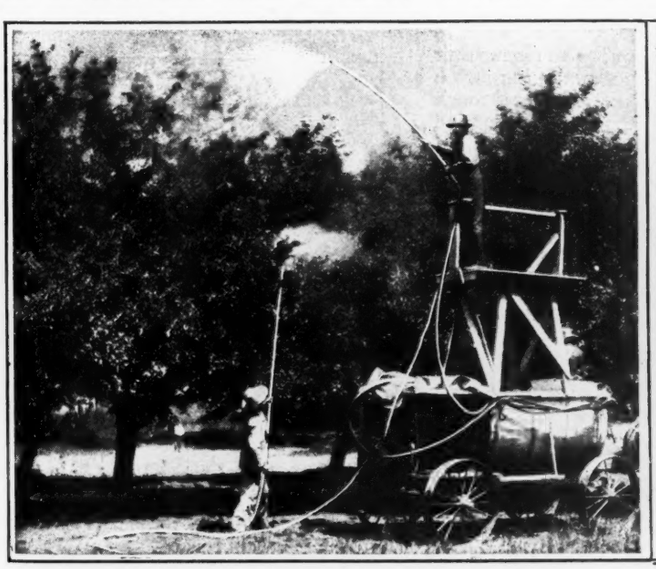
In addition to battles in the field, an effort is made to meet the invader at the border and there turn him back. The Secretary of Agriculture has arbitrary power to stop any product from coming into the country if he suspects it is carrying destructive pests. But despite the closest watch, the invaders are getting by.

One invader that entomologists of the United States fear is the human devouring ant. The most ferocious of this species is found in Africa. They travel in huge armies and devour everything in their path, including men. A smaller variety, which has been said to eat babies in their cradles, is native to Argentina.

We are not safe from the threat of such horrors as these. The Argentine ant already has found its way into England. We may be visited next.

Is it any wonder, then, that serious-minded scientists are asking seriously:

"Will man or insect survive?"



A modern "tank" on the battle line of man's war against insects. This power sprayer is used to combat the onslaughts of bugs on our fruit orchards

"No man's land" in Massachusetts, where the European corn borer is quarantined by the government. Green corn is barred from the territory marked by the sign

Paddle Tennis, Newest Game

School children in an exciting paddle tennis tournament at Washington Square, New York

PADDLE tennis, a new game for everybody, originated by the Rev. Frank P. Beal, of New York City, provides a substitute for lawn tennis for those who cannot afford to use expensive courts and rackets. A relatively small area marked out as a court, a few ropes stretched across for a net and homemade paddles of wood to serve as rackets, are all that is needed.

The rules of the game are the same as those of tennis.

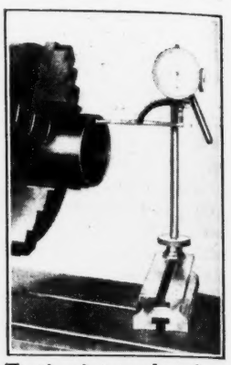
The court, with dimensions just half of those of a regular court, can be readily laid out indoors for play during bad weather. A regular net is not necessary, for two chairs set on each side of the court with ropes stretched between serve as an admirable substitute.

The originator of paddle tennis shows how to play the game

The wooden paddle is 14 inches long by 7½ inches wide and is made of several layers of wood. Such a racket is inexpensive and easily made.

Dial Tool Shows Accuracy of Machine Parts

A NEW precision tool recently perfected by a concern in Providence, R. I., quickly and accurately tests the trueness of surfaces of machine parts during the process of manufacture. Any variations are recorded on a dial.



Testing internal surface with dial indicator

The tool has a lever, one end of which presses against a plunger on the dial mechanism. The other end is brought into contact with the surface that is to be tested.

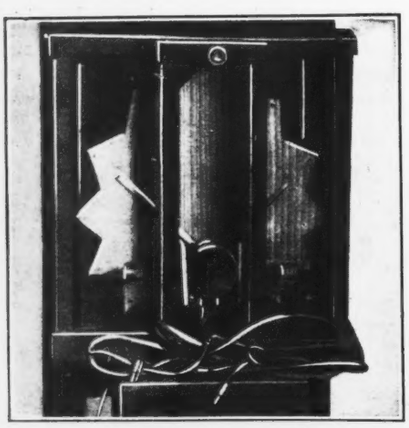
When the turning of the work causes no movement of the dial, the work is true.

The new tool is especially adapted for testing internal surfaces.

Nooks and Corners of U. S. Remain Unexplored

WITHIN the boundaries of the United States are areas that still remain unexplored. Many of the so-called "alcoves" of the Grand Canyon of the Colorado, for example, never have been penetrated. While many expeditions have explored and mapped the larger areas bordering this river, all have avoided these alcoves largely because of lack of water.

On one of the plateaus in Utah there are also many places that never have been mapped. Similarly in the Olympic Mountains of Washington.



Leaf-Shaped Spruce Used for Radio Loudspeaker

OF THE many ingenious loudspeakers recently devised to give quality and tone in radio reproduction, perhaps the most novel is the invention of R. H. Marriott, United States naval radio aide, of Bremerton, Wash. It utilizes a thin leaf-shaped spruce board as a vibrating surface.

The board is made of carefully selected Washington spruce, cut, braced, dried, and waterproofed to produce the desired tone and prevent warping. The panel is about 10 inches each way and is fastened to the frame. At the base of the leaf is attached an armature, actuated by the phone magnets in accordance with the current.

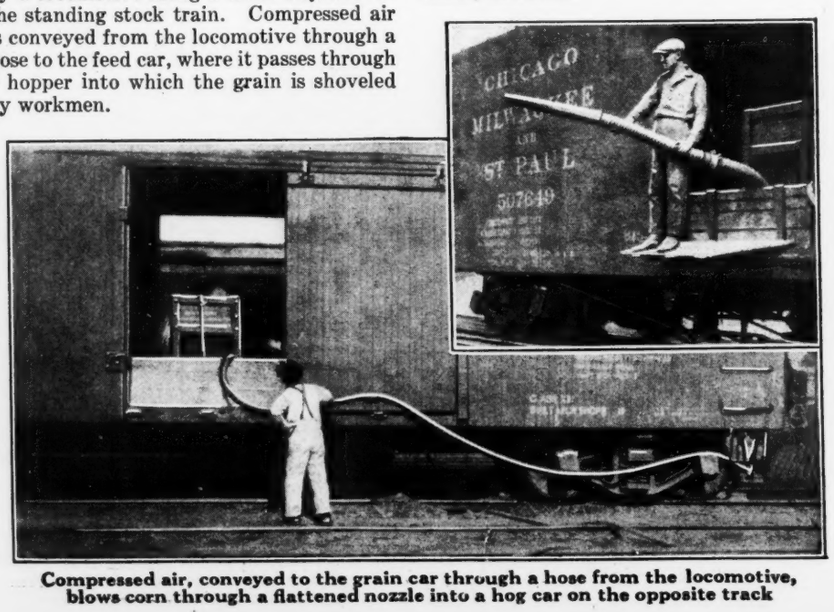
Compressed Air Feeds Corn to Hogs

TO FACILITATE the feeding of hogs that pass through Malden, Wash., by the carload, James McGarvey of that city has invented a pneumatic feeder that blows the grain into the hog cars and so distributes it to the animals.

A car carrying a supply of corn is pushed by a locomotive along a track adjacent to the standing stock train. Compressed air is conveyed from the locomotive through a hose to the feed car, where it passes through a hopper into which the grain is shoveled by workmen.

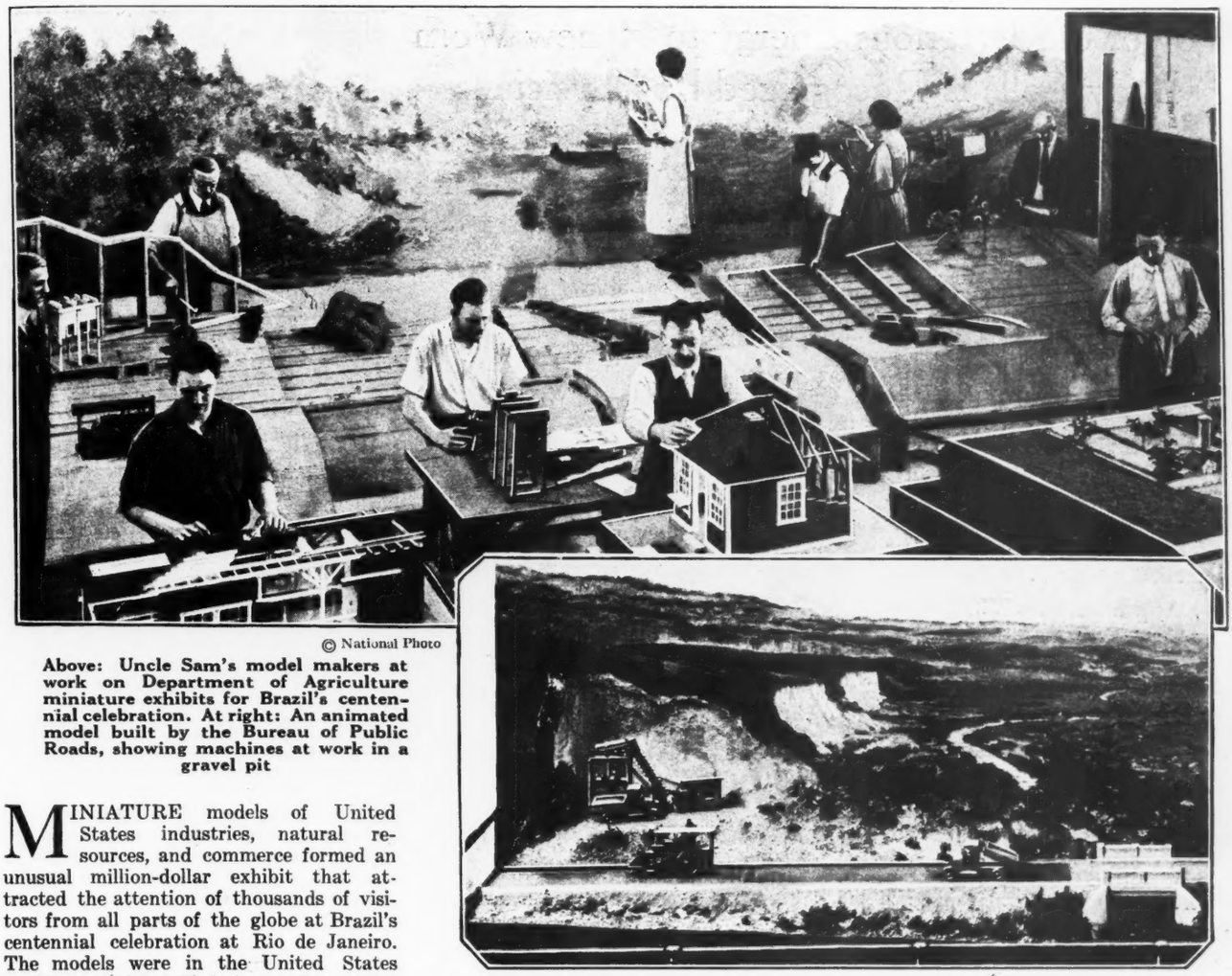
As the grain is picked up by compressed air from the hopper, it is shot out through a nozzle that is inserted between the slats of the stock car.

The hopper serves as a measure, and it is claimed that the use of this apparatus has resulted in a decided saving of time, labor, and feed.



Compressed air, conveyed to the grain car through a hose from the locomotive, blows corn through a flattened nozzle into a hog car on the opposite track

Models Show Uncle Sam's Industries



© National Photo

Above: Uncle Sam's model makers at work on Department of Agriculture miniature exhibits for Brazil's centennial celebration. At right: An animated model built by the Bureau of Public Roads, showing machines at work in a gravel pit

MINIATURE models of United States industries, natural resources, and commerce formed an unusual million-dollar exhibit that attracted the attention of thousands of visitors from all parts of the globe at Brazil's centennial celebration at Rio de Janeiro. The models were in the United States Building, which will be used later as a permanent embassy building.

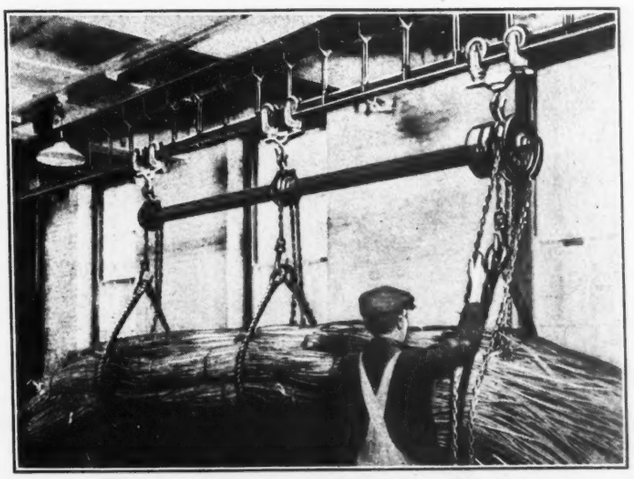
Many months of work were required to construct, technically accurate in every detail, the models that show faithfully this country's industries. An entire building in Washington, D. C., was turned over to the Division of Exhibits, Department of Agriculture, for the construction of its models for the centennial. This building was a busy hive of model makers.

Coal mining operations, methods of dredging for gold, map making, shipbuilding, automobile manufacture, roadbuilding, the Postal Department's activities, reclamation work, child welfare and education work, and a thousand other activities are realistically pictured in this exhibit.

An animated model built by the Bureau of Public Roads is particularly noteworthy. It is a perfect representation of actual work in a gravel pit, showing machinery for digging gravel, roadbuilding, highway drainage, and even a one-eighth-horsepower power house in operation.

Triple Hoist Lifts Limber Loads

AN UNUSUAL and useful triple hook hand hoist has been perfected by an Ohio manufacturer for elevating limber loads of great length, such as bundles of rattan, bamboo, wooden molding, wire and small metal bars or other flexible material that, although clumsily long, must be prevented from bending.



Three chain hoists are wound on trolley bar

The hoist is suspended from three one-half-ton plain trolleys running on an overhead rail. Chains from which three hooks are suspended, pass over sprocket wheels attached to a horizontal bar, at one end of which is the hoisting mechanism. This mechanism is a simple chain hoist, operated by hand, which turns the bar and rolls up the chains evenly.

POISON

We All Eat It

DID you have your morning dose of poison today?

"Poison?" you ask. "What do you mean?"

Well, the truth is, that if you had bacon for breakfast, salt on your cereal, bloaters or kippers, rolls covered with icing, pepper on any of your food, or even a cup of coffee or tea, you had your morning dose of poison.

Poison, of course, does not harm us if taken in sufficiently small amounts. Bacon contains a little saltpeter, an ounce being considered sufficient to kill.

The Chinese commit suicide by eating a cupful of salt; bloaters and kippers contain formaldehyde; most cake or roll icings have prussic acid in them; cloves, nutmegs, horseradish, and a number of other herbs are poisonous if taken in large enough quantities; black pepper contains piperine—an alkaloid poison; and doctors agree that overindulgence in coffee is most injurious because of its caffein content.

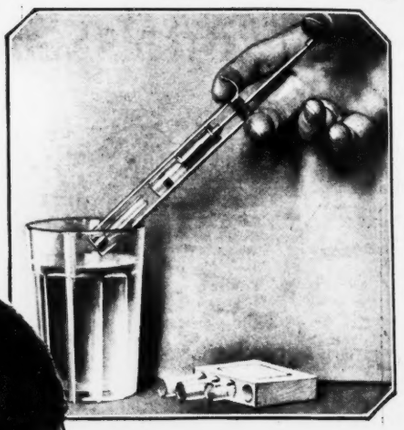
Will Radium Restore Youth?

Power of Mysterious Energy to Renew Worn Body Cells Is Recognized by Physicians

LONGER life.
New hair on bald heads.
A third set of natural teeth.
Renewed vigor of youth.

These are a few of the promises that the more optimistic radium experts are making for the use of radium emanation or radioactive waters in the treatment of disease and old age. And while recent glowing accounts of miraculous cures by radium therapy—as the new treatment is called—have not been accepted generally by the medical profession, there is a growing belief among physicians that radium emanation does have a definite place in medical treatment.

"Saratoga Springs" in the home. This apparatus is said to make ordinary drinking water radioactive



For office use, a handy syringe forces air through capsules of radium salts and into a glass of water, imparting radioactivity, its sponsors claim, to the drinking water

The "Spark of Life"?

Is it possible, as one physician has suggested, that in radium may be found the "spark of life"—the mysterious electronic force that drives the life of the world?

Constantly releasing mysterious energies with which the scientific world was not familiar until recently, radium, when introduced into the human system, produces a "kick" which, experts tell us, bombards our tired life cells into renewed activity.

"The fact is," says Dr. C. Everett Field, director of the Radium Institute of New York and one of the more conservative radium therapists, "that radium does not do the healing. But, for that matter, neither does any other form of healing. The healing exists within the organism. And radium, I am convinced, in some cases, is the most efficient medicine to give needed stimulus to the healing apparatus of diseased organisms."

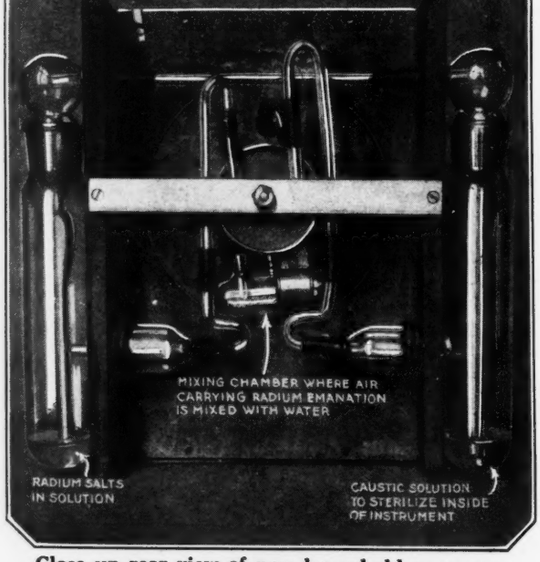
Even now, Doctor Field believes, radioactive treatment may prolong life at least 15 years.

For internal treatment two methods are used—either doses of radioactive water, or the administration of extremely minute quantities of radium itself. In the first case either waters from springs examined and found to contain traces of radium are used, or radium is used to make ordinary water radioactive. The difficulty with spring waters is that they lose their radioactive power when bottled and transported and so lose their value when not consumed at their source.

Radioactive Drinking Water

Because of this fact, a group of physicians interested in the use of radium as a curative stimulant have invented an ingenious device for imparting radioactive properties to ordinary water. As designed for use in the home, this instrument consists of a case containing an arrangement of glass tubes and vessels in which emanations from radium salts in solution are imparted to air, which is then mixed with the water.

A much simpler apparatus, available for office use, somewhat resembles a hypodermic syringe, containing special capsules of radium salts. Pushing a plunger forces air through the radium capsules and into a glass of water and is said to make the water radioactive. The doses of radium in each case are constant, because radium emanates at a constant rate and only a certain amount can be dissolved in water, no matter how many times a day the apparatus is brought into use.


MIXING CHAMBER WHERE AIR CARRYING RADIUM EMANATION IS MIXED WITH WATER
RADIUM SALTS IN SOLUTION
CAUSTIC SOLUTION TO STERILIZE INSIDE OF INSTRUMENT

Close-up rear view of new household apparatus for manufacturing radioactive water, showing arrangement of glass tubes for charging water with radium emanations

These constant emanations have been one of the great marvels of science ever since Madame Curie isolated radium from uranium ore in 1898. One gram of radium emits 136,000,000,000 atoms a second. As each atom disrupts, what is known as an *alpha* ray is emitted. This resultant atom disrupts in turn, emitting another *alpha* ray. And so the process continues. In the meantime, the mass of radium deteriorates into radium emanations. Radium thus loses half its strength in 1700 years and none of the original is left after 20,000 years of radiation.

Radium, a salt rather than a metal, is not a drug. It does not combine chemically with any known substance in the body. When taken in soluble form, 25 or 50 per cent of it remains in the body for four or five days. After that the rate of excretion is about only one per cent a day. Wherever it is located, it carries on a constant bombardment in releasing its energy, imparting strength to the tissues, cells, and protoplasma of the body. And when once these begin to function actively, they begin to rebuild themselves.

Radium Is a Stimulant

In external treatment by radium itself, emanations from a certain quantity of radium are allowed to focus on parts of the body over the diseased organs. In this way the curative functions of the diseased portion are stimulated to activity. The atrophying of diseased tonsils has been the most successful use of this form of treatment. The cure of cancer by radium, while claimed by some physicians, is generally discredited at the present time.

Whether radium treatment will prove able to restore youth to old age, grow new sets of teeth and perform other marvels that its more ardent supporters predict for it, only time will tell.

If radium treatment proves to facilitate the process of cell elimination, it will have gone a long way toward delivering the world from its enemies of disease.

Science Duplicates Costly Gems

Here is one of the world's most magnificent collections of gems—the Russian crown jewels, valued at more than half a billion dollars. In the center is the diamond studded crown of Russia, and beneath it the jeweled scepter of Catherine II, containing the famous Orloff diamond. Science soon may be able to duplicate all of these priceless gems

WITH the recent acceptance by the French Academy of Science of the Japanese cultured pearl as a real pearl, science has taken another forward step in the production of synthetic or artificial gems having all the attributes of the natural stones.

So rapid has been the progress of science in this direction that the dream of every woman who has visioned herself bedecked with glittering gems soon may be realized at a moderate cost.

It is even possible that science can reproduce such a wonderful collection as the crown jewels of Russia, valued at more than $500,000,000, now in the hands of the Soviet government.

The Emerald Has Defied Duplication

So far, science has reproduced four of the five aristocrats among precious stones—the diamond, ruby, sapphire, and pearl. The emerald has defied all laboratory experiments, but even its secret cannot remain hidden long.

The cultured pearl is a pearl in fact. It is made by the oyster in the same manner as the natural pearl. Science simply puts the oyster to work on a seed, or small bead, as a nucleus. This bead irritates the oyster, which covers the seed, layer on layer, with successive coatings of pearl.

The Japanese scientist, Mikimoto, recently has achieved remarkable success with cultured pearls. His process involves the most delicate and skilful manipulation. The shell is removed from a pearl oyster and a bead of nacre, or mother-of-pearl, is laid on the outer shell-secreting skin. This skin is cut off and made to envelop the bead, or seed, as a sac. Then the sac is transplanted and embedded in the body of another oyster. This oyster, with its pearl sac, is returned to the sea, where it remains for several years while successive coatings of pearl are secreted around the bead. The size of the pearl thus formed depends on the time the oyster is left undisturbed.

The base of an artificial ruby or a sapphire, like that of the genuine stones, is alumina, from which aluminum pots and pans are made. Briefly, the process is this:

Powdered alumina is caused to fall in a current of oxygen, which carries it to a combustion chamber. There the powder melts and forms a pear-shaped mass of sapphire or ruby, according to the color introduced. From this mass is cut the synthetic stone of science.

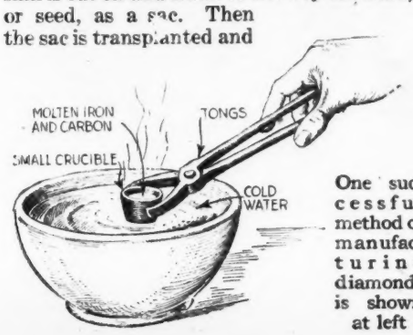
Artificial production of diamonds in a form fit for jewelry has been a baffling problem. Science has endeavored to follow Nature's volcanic process, but the pressure and temperature necessary to convert black carbon, charcoal, lampblack, or burnt sugar, into glittering, crystallized carbon that constitutes the diamond is extremely difficult to attain in a laboratory.

So far, the diamonds made by scientists have been no larger than the head of a pin.

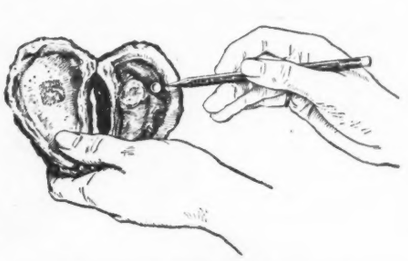
In 1893 a French chemist placed a mixture of pure iron and pure carbon in a crucible and subjected it to great heat. He then plunged the crucible into water, causing it to cool rapidly. The sudden cooling caused a crust of solid iron to form around the still molten and expanding interior so that great pressure and heat were realized at the same time. Some of the carbon formed into tiny diamonds.

Still more recently another chemist fused up olivine, and stirred it with a graphine rod. When cooled, it was found to be incrusted with small crystals of diamond.

The imperial Russian crown worn by the late Czar. It contains 32,800 carats of diamonds, as well as pearls, emeralds, and rarest rubies



One successful method of manufacturing diamonds is shown at left



The oyster builds a pearl around a bead inserted as a nucleus

Science Promises Cheaper Diamonds

In these partially successful experiments in manufacturing the hardest of all precious stones, science offers the promise that sooner or later it will evolve a process that will be simple and inexpensive.

When that time arrives, and when the secrets of the emerald have been discovered, the laboratories of science may be able to duplicate the Russian crown jewels and other of the world's precious gems.

Here is Huston, the champion Yankee Colonel who has seen a thousand games of baseball

How Scientific Baseball

Famous Owner of New York Yankees Tells "Inside" Secrets of Plays and Players that Draw Millions to the Nation's Ballparks

By Col. T. L. Huston

Who pays the highest salary in baseball—to Babe Ruth

"BULLET" JOE BUSH, of the New York Yankees, with a lead of 2 to 0 in his favor, held the New York Giants at his mercy in the first game of the 1922 World Series, until the eighth inning, and then——

Bancroft, the first man up in the eighth, cracked out the first ball pitched for a sizzling single.

Groh, the second man up, hit the first ball safely.

Frisch, the third man up, also smashed out a hit on the first ball.

Meusel, next up, repeated hitting the first ball Bush offered, and the batting rally that won the game for the Giants was over.

What caused this suddenly successful attack on Bush, who had the game practically won?

It was an intentional change of tactics on the part of the Giants, a bit of the science of psychology applied to baseball.

For baseball is a game of science. Psychology, mathematics, physiology, and physics are all important factors in the national sport. Of these psychology, the attempt to solve the human element in the game, is the most important.

Why Batter Passes First Ball

Every baseball fan knows that the batter generally lets the first pitched ball go by without attempting to hit it, but few know the reason for this practice, which has become one of the unwritten rules of baseball. The reason is based on psychology. The batter knows the pitcher probably has not been able to gage him because his size, distance, position at the plate, and batting habits are different from the preceding batter or, in case he is the first man up in the game, he presents an unknown quantity to the pitcher.

If, however, a pitcher is well warmed up and has the range of the batter, he puts the first ball directly over the plate, knowing the latter won't attempt to hit it.

Managers, quick to see a pitcher "grooving" the ball, then change tactics. Batters are ordered to hit the first ball pitched. Before the pitcher realizes that the batters are accepting his "good one," the batting rally is a thing of the past and the game is won. This was ably demonstrated by the Giants at the expense of the Yankees last year.

So it is that psychology is applied to baseball. The game is a constant battle of wits between rival managers and players. All other things being equal, the team able to "outguess" the other wins.

The "trapped ball" play offers another excellent example of psychology on the playing field. This is executed by letting a fly ball hit the ground and bounce into the hands, instead of making a clean catch in the air. George Burns, formerly of the Giants but now with Cincinnati, is the greatest exponent of this play in baseball today.

Burns is a psychologist. He knows he can always outguess base runners because he can change his mind at the last minute, a privilege denied them. Suppose there is a man on first base and another on second and the batter hits a fly ball to Burns. Burns knows that if the runners attempt to advance and he catches the ball on the fly, retiring the batter, he can throw either runner out. On the other hand, if the runners hold their bases, Burns lets the ball hit the ground, then traps it and simply throws to third base, forcing the man on second out. The third baseman throws to second, forcing out the man on first. This, of course, leaves the batter on first, but in the meantime two runners nearer the home plate have been retired. It's a mean situation for every one but Burns.

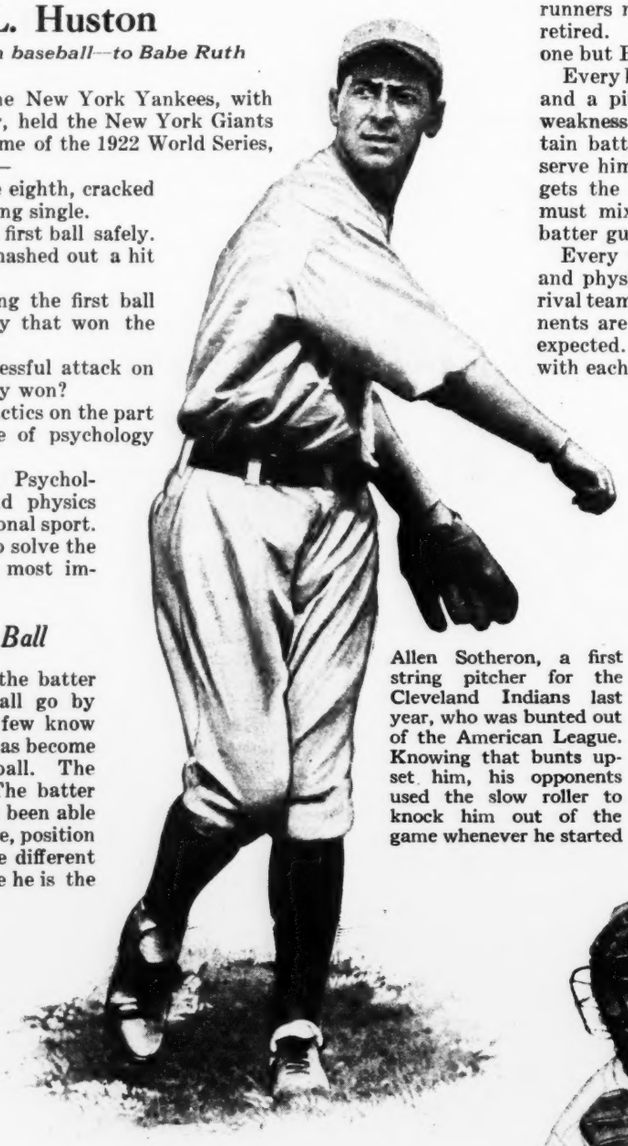
Every batter has some kind of a weakness and a pitcher must be able to find this weakness. For instance, if he finds a certain batter is hitting high balls, he must serve him low ones. If the batter finally gets the range on low balls, the pitcher must mix them up. He must keep the batter guessing.

Every manager must know the mental and physical habits of the players on the rival team. He must know what his opponents are expecting, and then do the unexpected. So baseball is a game of wits, with each team trying to outmaneuver the other.

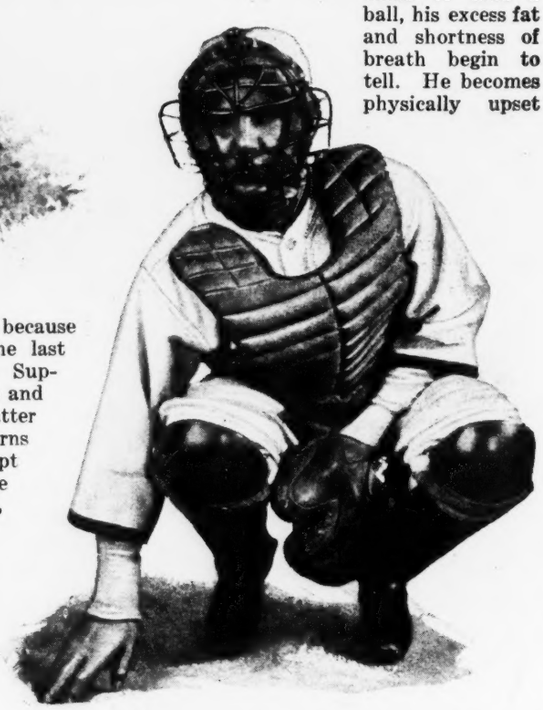
The science of physiology, too, ranks high in importance in its bearing on modern baseball. Players must be kept in perfect physical condition. Their stamina and speed must be maintained.

Take the case of a pitcher who fails to keep in good condition, who violates training rules or allows himself to become too fat. He will not last long. Opposing managers and players will apply a few simple experiments and the pitcher is through.

Bunting the ball to such a pitcher is a favorite way of wearing him out. After the pitcher has stooped over a few times to field a ball, his excess fat and shortness of breath begin to tell. He becomes physically upset



Allen Sotheron, a first string pitcher for the Cleveland Indians last year, who was bunted out of the American League. Knowing that bunts upset him, his opponents used the slow roller to knock him out of the game whenever he started



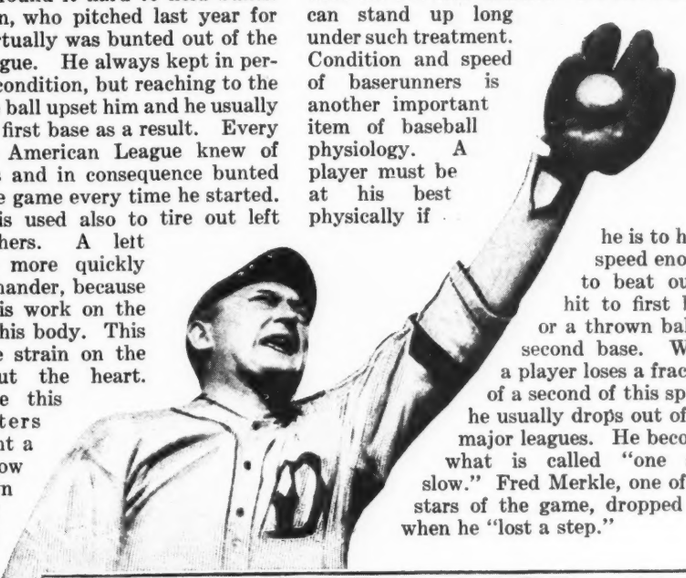
Ray Schalk, star catcher of the Chicago White Sox, who never goes after an impossible foul. Schalk has fouls down to a science

Is Played in the Big Leagues

and the umpire announces a new pitcher.

Bunting tactics were often used against "Bugs" Raymond with good effect. Phil Douglas also found it hard to field bunts. Allen Sotheron, who pitched last year for Cleveland, virtually was bunted out of the American League. He always kept in perfect physical condition, but reaching to the ground for the ball upset him and he usually threw wild to first base as a result. Every team in the American League knew of this weakness and in consequence bunted him out of the game every time he started.

The bunt is used also to tire out left handed pitchers. A left hander tires more quickly than a right hander, because he does all his work on the heart side of his body. This puts a severe strain on the muscles about the heart. To aggravate this strain, batters often will bunt a series of slow rollers down the right foul line, between the catcher and the first baseman. This leaves it up to the pitcher, who is forced to bend down on his left side and stretch with the left side muscles. No left hander can stand up long under such treatment. Condition and speed of baserunners is another important item of baseball physiology. A player must be at his best physically if he is to have speed enough to beat out a hit to first base or a thrown ball to second base. When a player loses a fraction of a second of this speed, he usually drops out of the major leagues. He becomes what is called "one step slow." Fred Merkle, one of the stars of the game, dropped out when he "lost a step."



Instant coordination of mind and muscle is vitally necessary. Babe Ruth's success at the bat is due to the fact that, when he is in trim, his coordination is perfect.

Baseball is based on mathematics. The diamond is laid out along geometrical lines and every foot of it is carefully charted. As in battle, the players are stationed at the danger spots. The distance between bases, 90 feet, was figured out mathematically on the basis of the speed of a batted or thrown ball as compared with the speed of an average baserunner.

With the aid of a specially designed machine, we have been able to determine that a ball can be thrown at a speed of 120 miles an hour, or 176 feet a second. Line drives often attain a speed of 220 feet a second. Grounders are slower, ranging from 65 miles an hour to the slow roller. The speed of fly balls has not been determined.

Compare these speeds with the speed of the average fast runner. The chances seem all against the player. But there is one thing that saves him—the time it takes to field the ball.

The average fast runner can cover the distance between (*Turn to page 101*)

The most remarkable photo of a baseball batting rally ever taken. With three men on bases, "Long George" Kelly of the New York Giants has just singled, driving in the winning runs in the last game of the 1922 World Series

Ty Cobb, of the Detroit Tigers, jumping for a high one in right field. Cobb is the greatest of all baserunners. He is one of three ball players who have stolen home in World Series games

Baseball's greatest psychologist, George Burns of the Cincinnati Reds, is shown at the right going after a fly ball. Will he make a fair catch of the fly, or "trap" it on the bounce? That's what baserunners never have been able to answer

How Modern Science Identifies Babies

How an infant's footprint is made for identification at the New York Nursery and Child's Hospital. The baby's foot is pressed against a sensitized card that bears also the mother's fingerprint. A preparation then is brushed over the imprint to bring out every line as shown at left

Footprints at Birth Remain as Individual "Tag" through Life

HERE'S a brand new baby who's going to be hard to lose.

He may possibly go astray temporarily in the shuffle of babies at the hospital. After he has learned to walk, he may run away. Perhaps kidnappers may get him, or he may be hit by an auto. And when he grows up he may go to war and lose his identification tag.

But sooner or later, whether baby or grown up, he's almost certain to be found, identified, and brought back to his parents.

He'll be found by his footprint—his baby footprint shown above, full of baby creases and wrinkles that will always remain his own indelible, individual "trade mark," no matter how big and how old he grows to be.

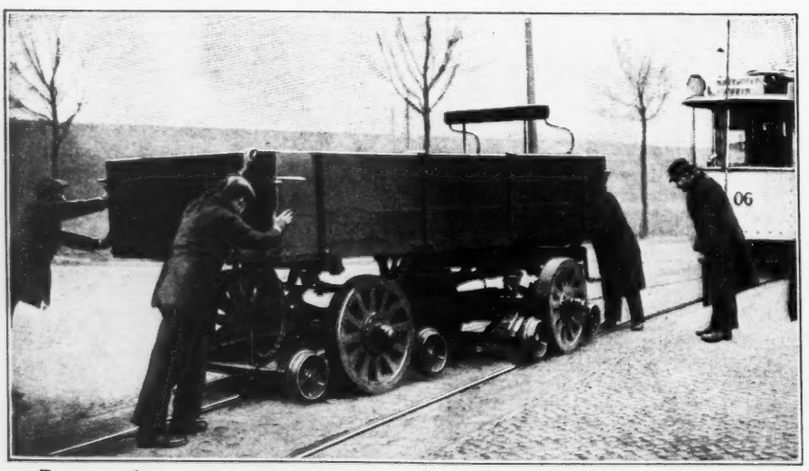
By our footprints, that never lose their first characteristics, scientists say, we can be sorted out from tens of thousands of persons. Science has just placed its final stamp of approval on this form of identification, with the result that in New York state legislation has been proposed to make it illegal for any doctor to file a birth certificate that does not include the footprints of the baby at birth, with the thumbprint of the mother.

Footprinting of babies originated at the New York Nursery and Child's Hospital nearly two years ago. Since then, more than 1600 baby footprints have been made in this institution.

The method is extremely simple. Soon after a baby is born, his footprints and the mother's fingerprints are made on the same card. The baby's foot is pressed on a sensitized card. Then the nurse dips a brush into a tub of black compound and rubs the brush gently over the spot where the foot impression was made. As the black is rubbed in, slowly the print of the child's foot appears. A coating of shellac mixture that serves as a preservative, then is sprayed over the print by means of an atomizer.

Mrs. Mary E. Hamilton, New York City's famous policewoman, who probably knows as much about finding missing persons as any one in America, predicts that eventually this plan of identification will be adopted by all the states. She believes it will simplify hundreds of problems that now baffle police departments and government officers in pursuing missing person investigations.

Streetcars Haul Truck-Trailers



Because of a scarcity of motor trucks and horses in Germany, Berlin street railways have devised this novel trailer-truck to haul heavy loads along streetcar tracks. The truck, equipped with four auxiliary flanged railway wheels, is pulled by the ordinary street trolley cars

Housewives Can Save Gas in Cooking

RECENT experiments conducted by the United States Bureau of Standards show that the average housewife wastes entirely too much gas in cooking.

Since water in open vessels cannot reach a temperature above 212 degrees, prolonged violent boiling, with the consequent consumption of gas, is unnecessary. An economic rule to follow, the experimenters say, is to keep the gas flame on full until the water starts to boil, then reduce the size of the flame to a point where the water merely simmers.

The best results were obtained by keeping the tip of the gas flame just touching the bottom of the vessel, without extending up and around the sides. A distance of about 1¼ inches between the burner and the bottom of the container was found to be most satisfactory.

Happiness in Hobbies

Robert Anderson, above, talented character actor for the movies, spends his leisure hours making things with tools in the workshop that he has installed in his home at Universal City. He is here adjusting a friction drive bench drill

Totally blind, yet inventor of a score of ingenious labor saving devices, H. S. Barlow, of Yonkers, N. Y. (right), is now active head of his own $300,000 manufacturing corporation. When his eyes began to fail him, 10 years ago, Barlow took up the use of tools as a recreation. He is shown here with a home wringer and general domestic power unit that he recently marketed

The most valuable private collection of rare birds in the world is the hobby of Baldwin Palmer, Brooklyn, N. Y., manufacturer. A prize of the collection is shown, in the hands of an attendant, ready to take a dose of castor oil. Among Mr. Baldwin's prizes is a pure white Indian peacock, said to be worth $10,000

15 MINUTES A DAY

KEEP FIT! EXERCISE

Posed in Person by U. S. Senator Royal S. Copeland

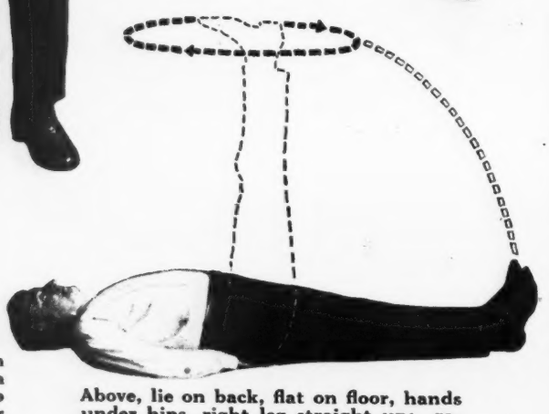
DOCTOR COPELAND, as Health Commissioner of New York City, has attained a reputation as one of the foremost health authorities of the country.

At left, for muscles of arms and sides: Hold arms straight up and swing alternately up and down rapidly

At right, for muscles of stomach and back: Swing arms smartly across chest, and then bend forward from waist

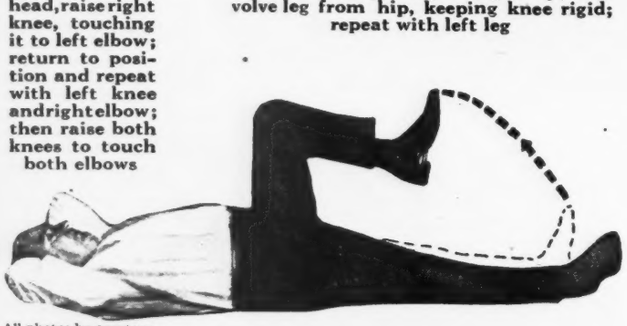
Note: Repeat each exercise from five to 10 times

For back, legs, and chest: Stand erect, arms stretching upward; step forward with left foot; bend forward smartly from hips, swinging arms downward



Above, lie on back, flat on floor, hands under hips, right leg straight up; revolve leg from hip, keeping knee rigid; repeat with left leg

Below, lie on back, flat on floor; clasp hands under head, raise right knee, touching it to left elbow; return to position and repeat with left knee and right elbow; then raise both knees to touch both elbows



All photos by courtesy *N. Y. Evening World*

Above, lie on floor, face down, palms on floor at shoulder line; raise body from floor, supporting it on toes and forearms

Try This Method of

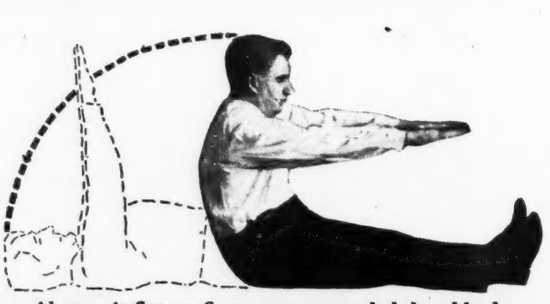
HOW close to 100 per cent physical fitness are you? Dr. A. K. Aldinger, Director of Physical Education in the New York Public Schools, has prepared a series of tests. Try them on yourself.

Allow yourself 30 points if you are free from remediable physical defects—that is, if your sight, hearing, and teeth are in good condition, if you breathe properly through your nose, and do not suffer from fallen arches. Subtract one point for slight defects in each of these classes, and two points for serious defects. Allow yourself 30 points more if your posture is correct. To test this, stand beside an upright curtain pole, as in the accompanying sketch; if you stand as shown by the figure at left, your rating is only 15 points; if you stand as at right, your rating is 30 points. Let a friend judge of the exact rating you should have. You now have a possible 60 points.

Then put yourself through the following four tests, totalling 40 points.

Pull-Ups—10 Points

Chin yourself as many times as you can. The first three pull-ups count one; each additional one counts one point; 12 therefore give you the total of 10 points.

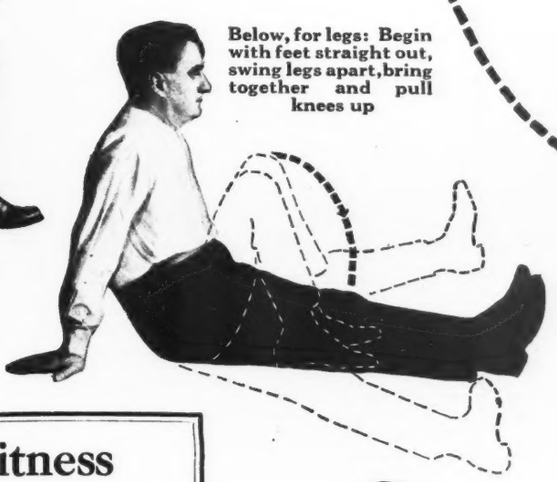


Above, sit flat on floor, arms extended; bend body halfway back, recover, bend all the way back

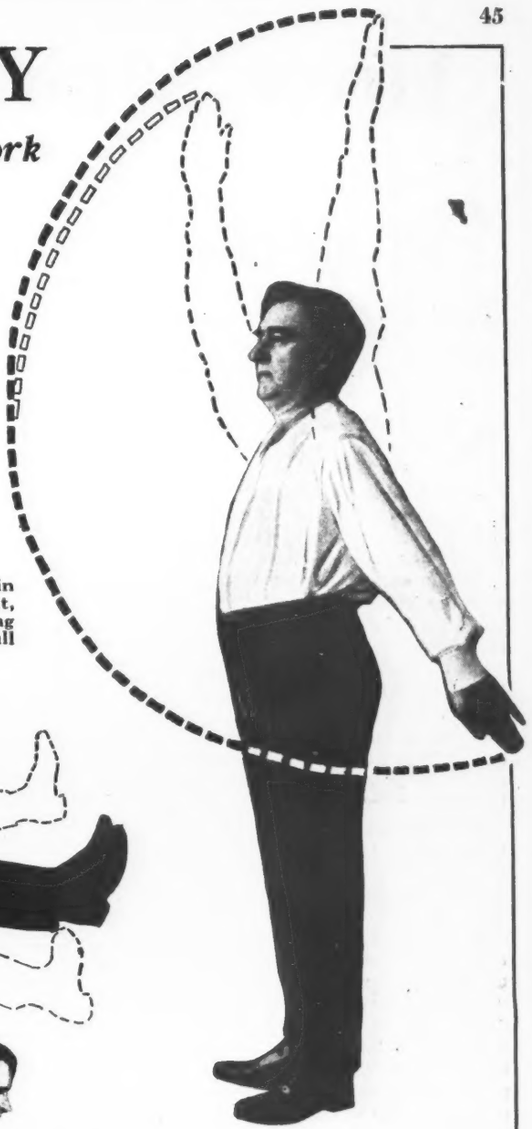
15 MINUTES A DAY

Former Health Commissioner of New York

Above, stand erect, arms stretching sideways; step forward with right foot, bending the body forward and crossing forearms behind the right knee



Below, for legs: Begin with feet straight out, swing legs apart, bring together and pull knees up



At right, for chest: Stand erect, arms stretching upward; bring arms forward, downward and back as far as possible; return to original position with brisk swing

Testing Your Fitness

Grip—10 Points

Using an ordinary grip dynamometer, find out how strong your grip is. A grip of 30 pounds counts one point; each additional 10 pounds counts one point; thus you must show 120 pounds grip to make the full 10 points in this test.

Basketball Goals—10 Points

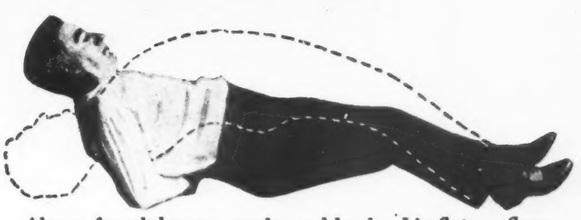
Start with a basketball anywhere on the floor and begin to shoot, trying for as many baskets as you can make in 30 seconds. Each goal counts one point. Ten goals in 30 seconds gives you 10 points.

Broad Jump—10 Points

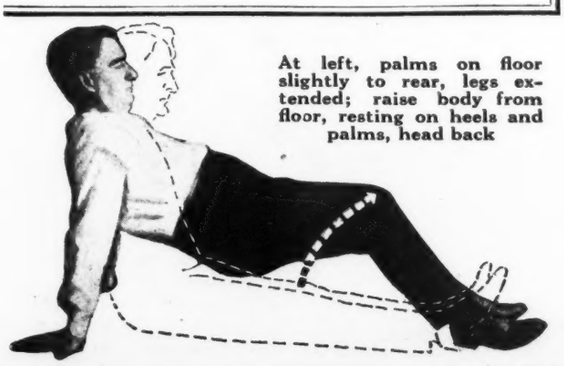
In a standing broad jump, if you do three feet six inches, you get one point; every additional six inches gives you one point, so that an eight-foot broad jump is required to give you 10 points.

The average man should score 70 points, according to Senator Royal S. Copeland, former Health Commissioner of New York City, who especially posed for the series of exercises on this page.

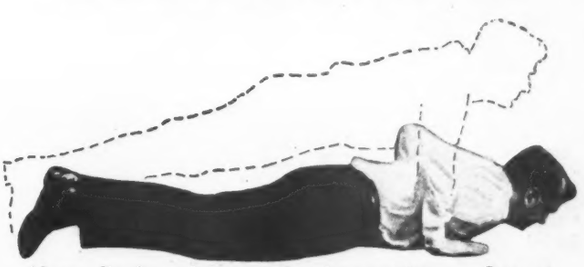
At left, for legs and body muscles: Sit on floor, legs extended; bend right knee, bringing foot as close to body as possible



Above, for abdomen, neck, and back: Lie flat on floor, clasping hands behind small of back; raise body, bending upward from waist with heels and head on floor



At left, palms on floor slightly to rear, legs extended; raise body from floor, resting on heels and palms, head back



Above, lie face down with palms resting on floor at shoulder line; raise body from floor, supporting it on palms and toes, head down

How Much Do You Know about Science?

Thirty Questions and Answers to Test Your Knowledge

The Human Machine—How Things Work—What Things Are Made Of

Answers to the questions asked in this article are published on page 104.

NEARLY every one wants to know the fascinating facts about the world we live in. Most of us are anxious to possess a background of knowledge, a reserve fund of general information outside the narrow limits of our own business or profession.

Yet how many of us are really acquainted with the most common scientific facts about the things, the events, and the people around us?

These wonderful facts of science have been literally locked away from us. They have been stored away in involved textbooks or in bulky encyclopedias that repel, rather than attract us. We have passed them by; and as a result, we have tended to become narrow, one-sided.

It is to give the busy man or woman a ready access to the every-day wonders of science, to present scientific facts in a simple, readable way, that POPULAR SCIENCE MONTHLY has compiled thousands of questions that have come from our readers and from school children throughout the country.

The questions on this page are typical of the queries received from our readers. There are no trick questions, no traps for the unwary. They will help test your mental equipment. Go over them. Find out where you are weak. You'll discover in them a fascinating short cut to accurate knowledge—a liberal education in a nutshell.

Here they are. Go to it!

HERE are three sets of 10 questions each, dealing with important, every-day facts of science. They have been selected from a mass of questions asked by more than 6000 POPULAR SCIENCE MONTHLY readers and by 20,000 students.

How many can you answer?

First, study the 30 questions, answer them to the best of your ability; then turn to the correct answers on page 104. Grade yourself 10 for each question answered correctly, and see how near you can come to a 100 score for each classification.

The Human Machine

WHAT do you know about the wonderful mechanism of your body?

1. Why do we get tired?
2. How many hairs are on your head?
3. What makes hair turn gray?
4. How many bones are there in the human body?
5. Why does a bump come instead of a dent when you knock your head?
6. What causes fainting?
7. What makes us sneeze?
8. What is the average weight of babies at birth?
9. What diseases have caused the greatest number of deaths among the white race?
10. How do we catch cold?

What Things Are Made Of

DO YOU know what the water you drink every day is made of? Probably you do, but how familiar are you with other things that you use every day?

1. What is the difference between atoms and molecules?
2. What is iron?
3. What is radium?
4. What is the smallest measurable distance?
5. What is the heaviest substance known?
6. What is the lightest metal?
7. Why are gold coins made of impure gold?
8. What is coal?
9. What is smoke?
10. How is alcohol made?

How Things Work

HOW much do you know of the things that are happening around you every day? See how many of the following 10 questions you can answer.

1. Why does a rubber ball bounce?
2. Why do people standing in a moving streetcar fall forward when the car stops?
3. What makes a pitched baseball curve?
4. Why can flies walk on the ceiling?
5. Why are woolen clothes warmer than cotton ones?
6. Why is ice placed in the top of a refrigerator?
7. Why are automobile tires more likely to blow out on a hot day?
8. Why do you see a gun flash before you hear the report?
9. What makes the murmur in a seashell?
10. Why does cold glassware crack when put into boiling water?

Next month—the stars, the earth, every-day chemistry.

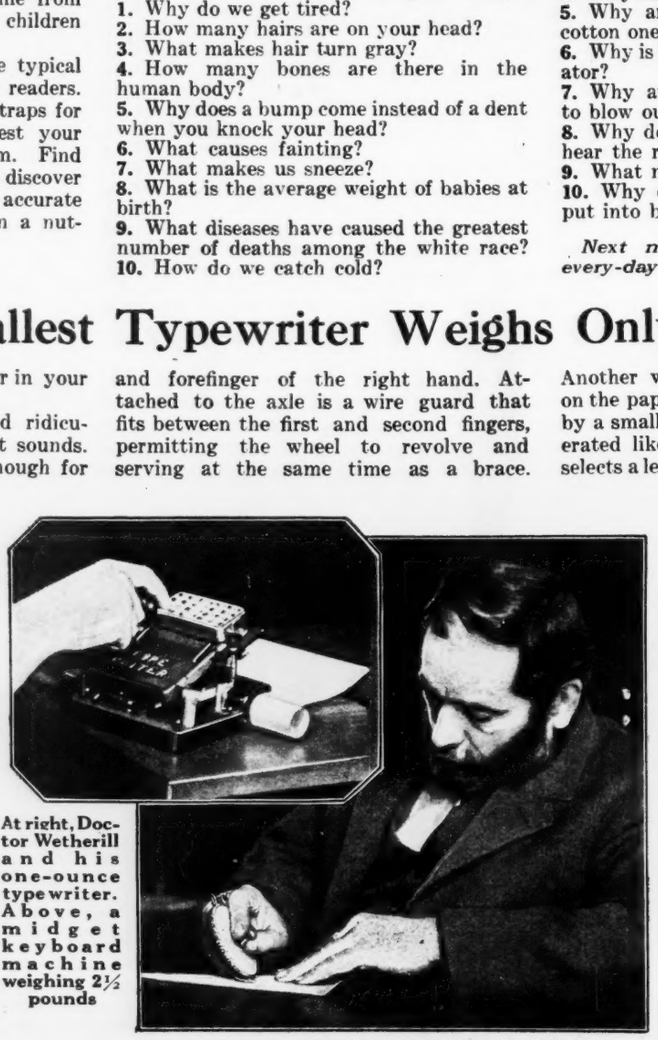
World's Smallest Typewriter Weighs Only an Ounce

HAVE you a little typewriter in your vest pocket?

The question may sound ridiculous, but it isn't as foolish as it sounds. A one-ounce typewriter, small enough for you to carry in your vest pocket, has been perfected by an unusual inventor, Dr. Henry Emerson Wetherill, of Audubon, Penn. And the remarkable part of it is that, although the invention of the machine was announced only recently, Doctor Wetherill, who is the inventor of nearly 50 practical devices, has used it for nearly a dozen years.

The midget typewriter, it is claimed, does away with the plea, "I can't write." Nearly any one can learn to write with this simple device.

The machine is simply a disk, or wheel, faced with letters and figures in rubber. The wheel containing them is made of aluminum, rotating on a small wooden peg or axle. In operation, this axle is grasped between the thumb and forefinger of the right hand. Attached to the axle is a wire guard that fits between the first and second fingers, permitting the wheel to revolve and serving at the same time as a brace. Another wire projects downward, resting on the paper from which the wheel is held by a small spring. The device is then operated like a hand stamp. The operator selects a letter by spinning the wheel. When this letter is directly over the paper, he presses down. Doctor Wetherill has equipped the spinning peg with an ingenious series of marks by which, he asserts, it is possible, with some practice, to operate the contrivance by the "touch system."

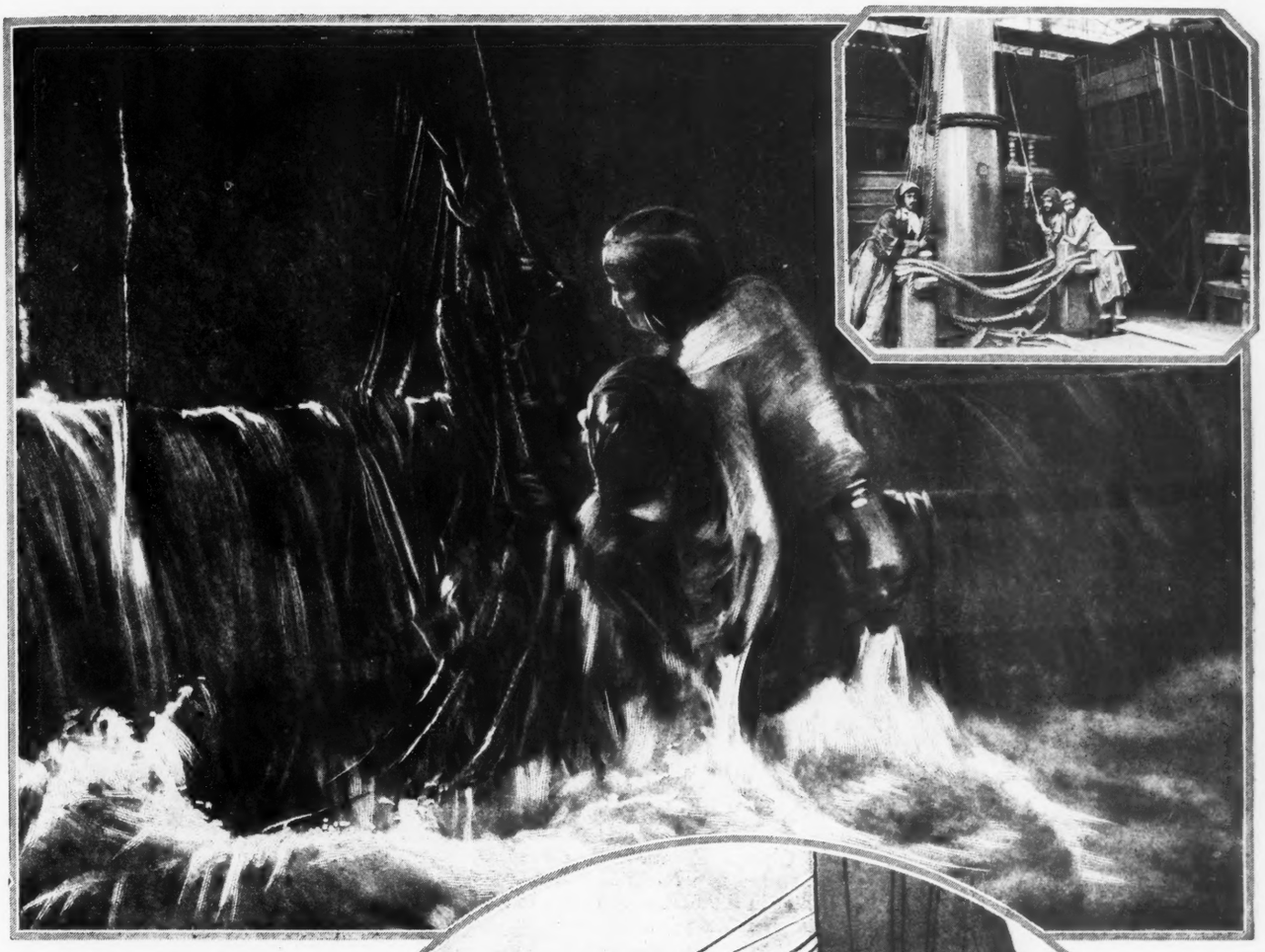


At right, Doctor Wetherill and his one-ounce typewriter. Above, a midget keyboard machine weighing 2½ pounds

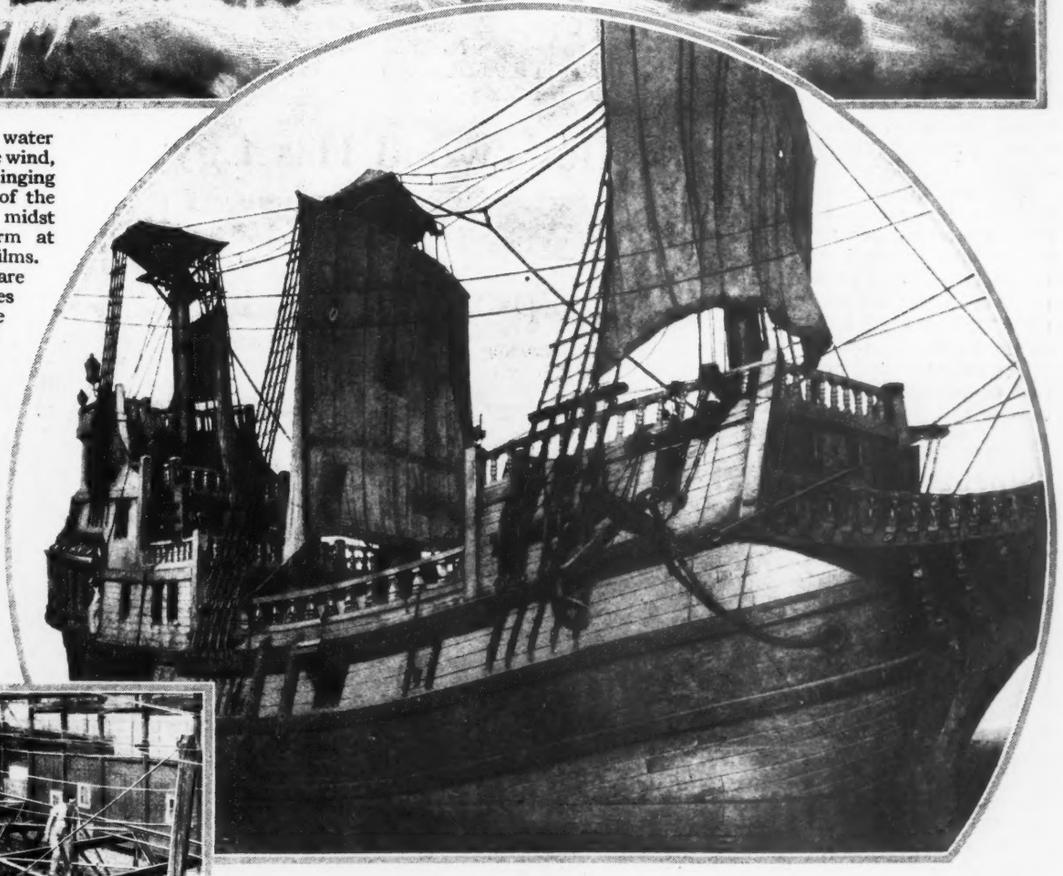
The letters are inked by a small spool revolving just above the wheel and surmounting the top guard, where it rests between the first and second fingers. Almost any sized type may be used.

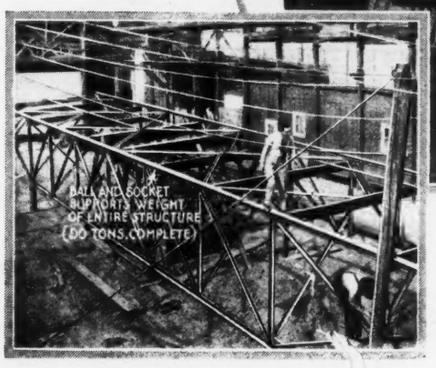
Running a close second to Doctor Wetherill's typewriter is a keyboard typewriting machine, invented by F. G. Stallman, of South Norwalk, Conn., that measures only five by seven inches and weighs only 2½ pounds. This machine is said to turn out letters nearly as well as standard typewriters.

Movies Stage Most Vivid Storm



DELUGED by tons of water and buffeted by the wind, these characters are clinging to the side of a replica of the "Mayflower" in the midst of the most vivid storm at sea ever staged for the films. Mechanical ingenuity, rare even for a Los Angeles movie director, has gone into the staging of this scene from a forthcoming photoplay based on the story of Miles Standish. The inset in upper right shows a scene on the "Mayflower's" deck, including one of the big tanks from which water is released with such force as to knock down the actors struggling through their parts





THE reproduction of the "Mayflower," above, seems to float gracefully in a huge pool; but as a matter of fact, it has no bottom and is only half a hull mounted on the steel frame along which Charles Ray (star of the film) is shown walking at left. The whole structure rests on a ball-and-socket pivot and is raised on a concrete post supporting it at the center. A small engine tilts the frame, giving the ship an intricate pitching and rolling motion exactly like that of a storm-tossed vessel

Speeding Up Parcel Post

Courtesy *Edison Monthly*

Above: Truck operating along the street. At left: Loading mail sacks

THE problem of collecting and carrying large quantities of parcel post packages to and from the post office has been solved by a large coat and suit house in New York. It has installed specially designed electric trucks that can be operated, not only in the company's building, but along paved streets as well.

The body of the truck is made of steel and has one steel compartment. Mail sacks are loaded and unloaded through a hinged door at the side equipped with a lock. The electric storage battery, composed of 12 cells, supplies power enough to drive loads weighing a ton. An automatic charging plug facilitates recharging.

The body was designed to fit an elevator that carries the trucks from floor to floor to collect parcels.

Singing to Cure Deafness and Head Noises

THAT humming and singing will cure head noises and make it possible for partially deaf persons to regain their hearing is the contention of Dr. Paul V. Winslow, attending ear, nose, and throat surgeon at the Brooklyn State Hospital, New York.

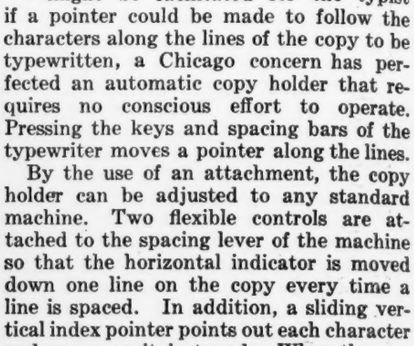
After innumerable experiments, Doctor Winslow has prescribed a series of exercises in singing and humming. For example, he declares that it is excellent practice to hum the consonant "M" in such a way that the lips can be felt vibrating, or to sing the vowel "E" for two-minute periods three times a day, placing the tone high up in the nasal chambers with a decided nasal twang.

One deaf patient who could not hear his own voice is said to have succeeded by this method in hearing voices three feet from his right ear and six inches from his left.

Automatic Copy Holder Guides the Typist

REALIZING that the copying of letters might be facilitated for the typist if a pointer could be made to follow the characters along the lines of the copy to be typewritten, a Chicago concern has perfected an automatic copy holder that requires no conscious effort to operate. Pressing the keys and spacing bars of the typewriter moves a pointer along the lines.

By the use of an attachment, the copy holder can be adjusted to any standard machine. Two flexible controls are attached to the spacing lever of the machine so that the horizontal indicator is moved down one line on the copy every time a line is spaced. In addition, a sliding vertical index pointer points out each character and space as it is typed. When the carriage is moved back to the beginning of a line, the index pointer also moves back.

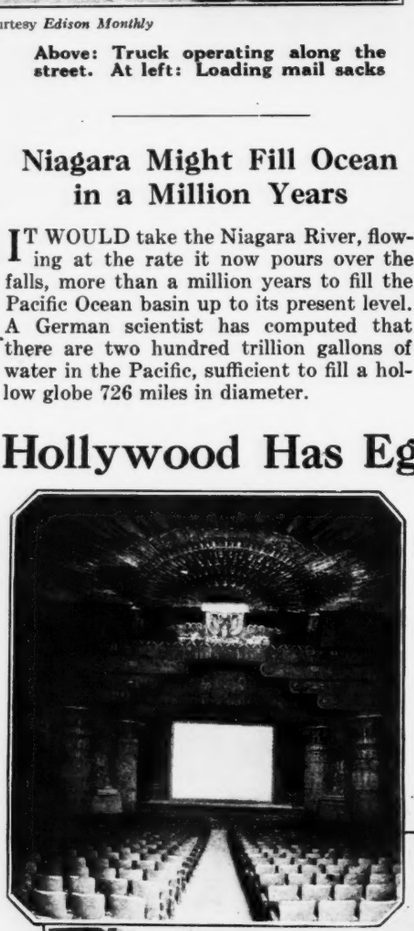


A pointer moves from word to word as the typist copies

Niagara Might Fill Ocean in a Million Years

IT WOULD take the Niagara River, flowing at the rate it now pours over the falls, more than a million years to fill the Pacific Ocean basin up to its present level. A German scientist has computed that there are two hundred trillion gallons of water in the Pacific, sufficient to fill a hollow globe 726 miles in diameter.

Hollywood Has Egyptian Film Temple



BEAUTIES of Egyptian temple architecture and decoration have been reproduced in an elaborate new $800,000 film palace in Hollywood, Calif.

The new theater is unique in that the building is set back 150 feet from the street and is fronted by a beautiful courtyard, 45 feet wide. This courtyard is lined on one side with attractive shops, and on the other by a high wall decorated with Egyptian hieroglyphics.

The theater seats 1760 persons. Within, the auditorium is illuminated by reflected light from concealed lamps.

Courtyard and interior of the $800,000 Egyptian movie temple at Hollywood, Calif.

Oil from Shale Mined by Steam

Ingenious Method Forces Vaporized Fuel from Blasted Deposits

AN ENTIRELY new method has been invented by Wilson W. Hoover and Thomas E. Brown, of New York, of combining the mining of shale and the extraction of oil from it. They believe that the time will come when we shall be forced to get most of our oil fuel from the vast oil-bearing shale deposits of the Rocky Mountains.

They plan first to break up the shale below the surface by dynamiting, then to pass superheated steam through the broken deposits, causing vaporized oil to rise to the surface through conducting pipes.

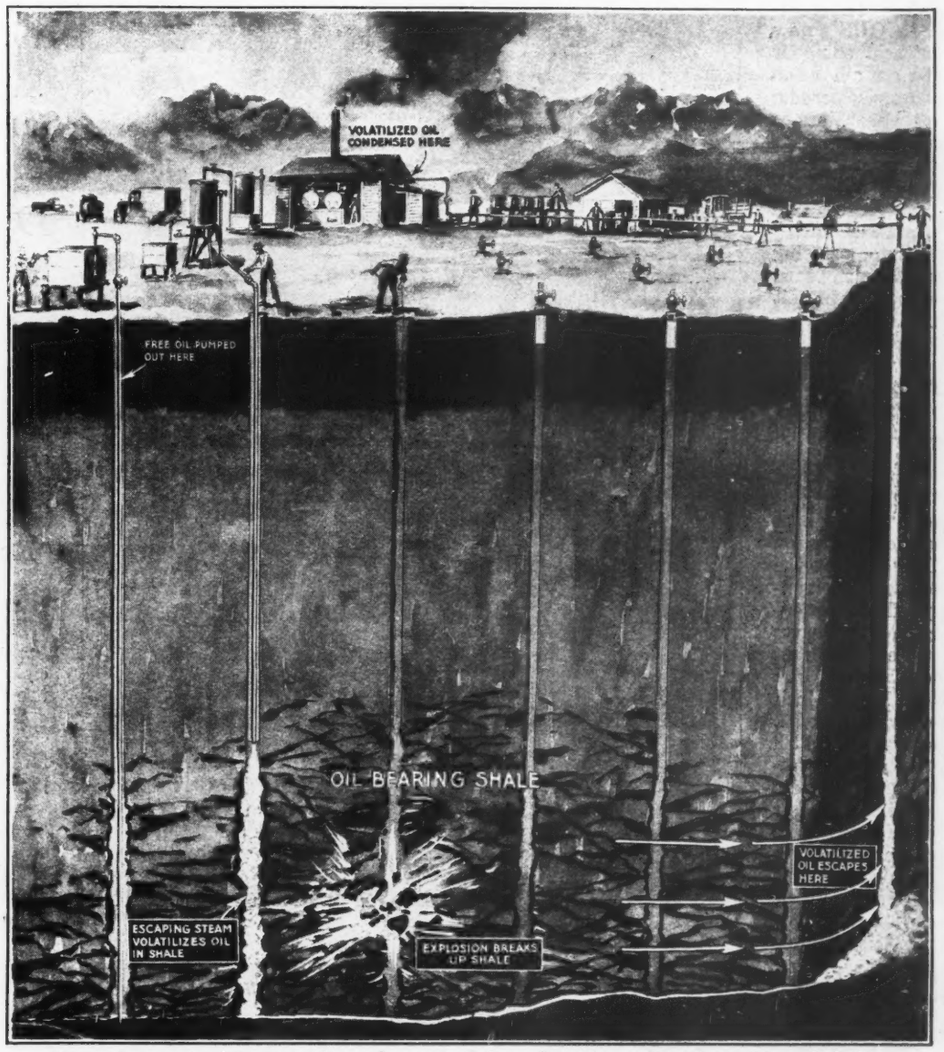
A similar method applied to the mining of sulphur has met with tremendous success. Only 20 years ago we imported practically all of our sulphur, notwithstanding the fact that large deposits occur in Louisiana and Texas. Today, through the use of the steam method, we not only produce our own, but export large quantities.

By the Hoover-Brown plan of mining oil shales, a series of holes, close together, are drilled over a shale-bearing area. The underground oil-bearing shale deposits are then shattered by explosives up to 100 feet of the surface, creating a zone of fracture.

All but two of the drilled holes are then sealed, one being used to conduct superheated steam to the fractured area of shale, the other to carry off distillates of petroleum created by the superheated steam under pressure.

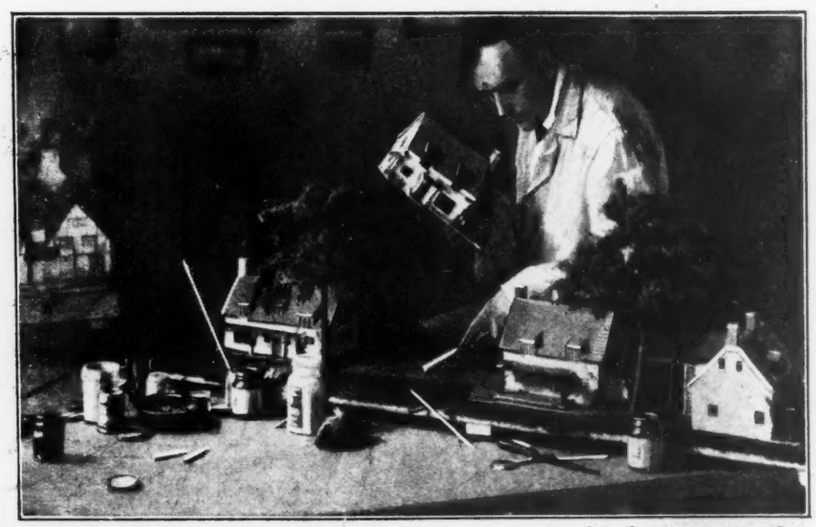
These petroleum distillates are deposited in various receptacles, being separated because they distill and condense at various degrees of temperature.

The method is not financially practicable under present conditions, it is said; but since America's oil supply is constantly growing less and the demand greater, it is expected to prove extremely valuable before many years.


VOLATILIZED OIL CONDENSED HERE
FREE OIL PUMPED OUT HERE
OIL BEARING SHALE
VOLATILIZED OIL ESCAPES HERE
ESCAPING STEAM VOLATILIZES OIL IN SHALE
EXPLOSION BREAKS UP SHALE

How oil, vaporized by superheated steam, is forced to the surface from blasted shale

Architect Substitutes Model Homes for Blueprints



Complete in detail, the architect's model homes are placed in a setting of trees, lawns, and walks, showing prospective owners how their homes will look

SURE that "seeing is believing," Henry Woodsend, an English architect, has adopted the ingenious plan of building models of homes for his clients instead of trying to explain the intricate blueprints.

The building of models for the purpose of instructing architectural students has been practised for several years at Columbia University, but application to the commercial field is a distinct innovation.

Woodsend first draws up a set of plans in accordance with the wishes of his client. Then he constructs a cardboard model on a one-quarter or one-eighth inch scale, paints it and sets it in the midst of realistic miniature trees, lawns, and walks. The completed model shows in the minutest detail how the finished home will look.

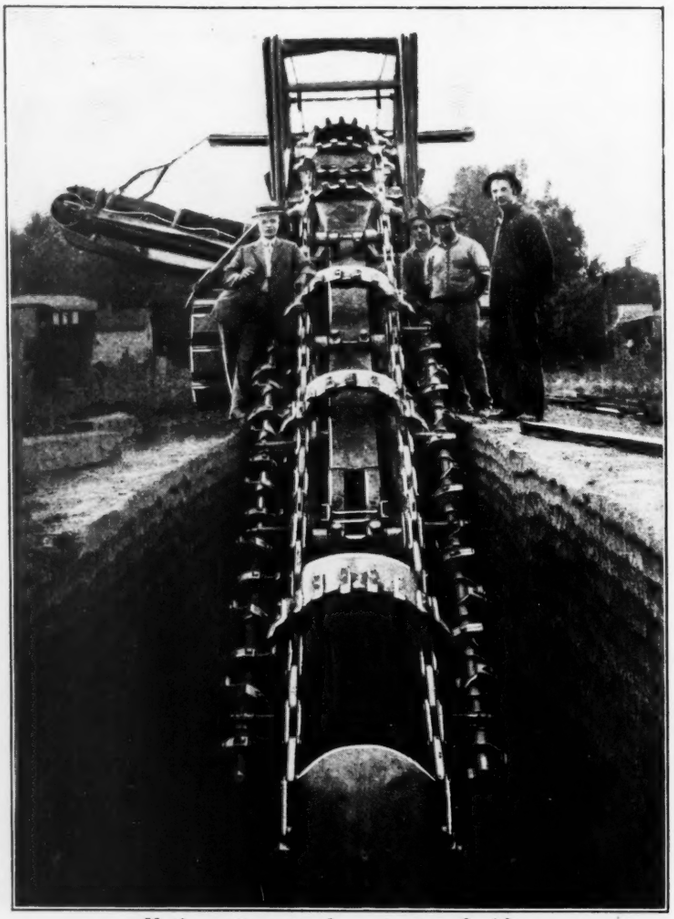
Before starting on that summer auto tour, you'll want to know about the season's most useful auto camping accessories designed for comfort along the road. Look for all the latest ones, pictured in the July POPULAR SCIENCE MONTHLY.

A New Wide-Ditch Cutter

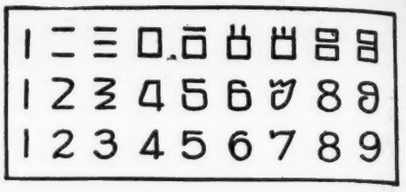
AN INGENIOUS new attachment for trench excavators permits one machine to cut ditches of various widths up to twice the width of the main machine.

Two sloping shafts along each side of the bucket frame are equipped with a series of cutters. These cutters scrape the dirt from the sides of the ditch and drop it into the bottom, where the buckets scoop it up. Power for the cutters is supplied by the engine that drives the bucket chains.

The 24-inch excavator model, equipped with the cutter attachment, can dig 48-inch trenches in a single operation. A larger model of the machine will cut a 72-inch ditch.



Notice cutter attachments at each side



How Modern Numerals Were Evolved

DID you know that numerals in the form we use today are a comparatively modern development—no older than the tenth century?

They began with a series of figures, each made up of straight lines, corresponding in number to the numeral quantity they were to represent. Thus a single vertical line was one, two horizontal lines represented two, and so on, as shown in the top row of the illustration above. Rapid motion in drawing these lines soon combined them, as shown in the middle row. Further slurring resulted in our modern numerals.

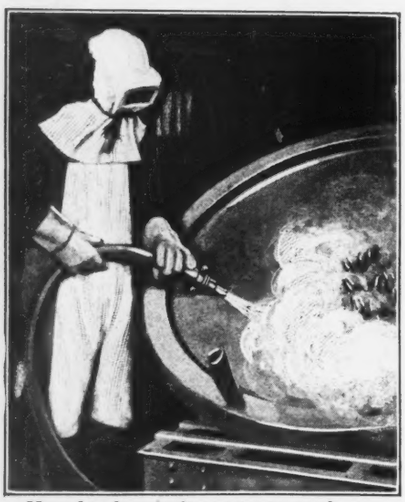
Reading Printed Words on Charred Paper

THE Bureau of Standards was called upon recently to find a method for deciphering written and printed matter contained on charred paper.

The method finally used was to place the sheets between two photographic plates for two weeks. By this time a readable impression had been produced on both plates.

This, it is claimed, was the result of gases given off by the paper, which affected the sensitive plates in the same way as light. The ink of the printed matter served as a cover that prevented free escape of the gases and therefore it left lighter traces.

Suit of Leather Armor Protects "Sand" Blaster



How leather suit protects workman

THE increased use of steel shot and grit as abrasives for "sand" blasting has necessitated the use of armored suits to protect workmen from the rebounding particles.

The suit consists of a hood and an apron of chrome leather. The hood is equipped with a finely woven wire sight screen that permits free vision while protecting the eyes and face.

Since the new abrasives are 2½ times as heavy as sand, they strike a sharper blow and rebound with greater force.

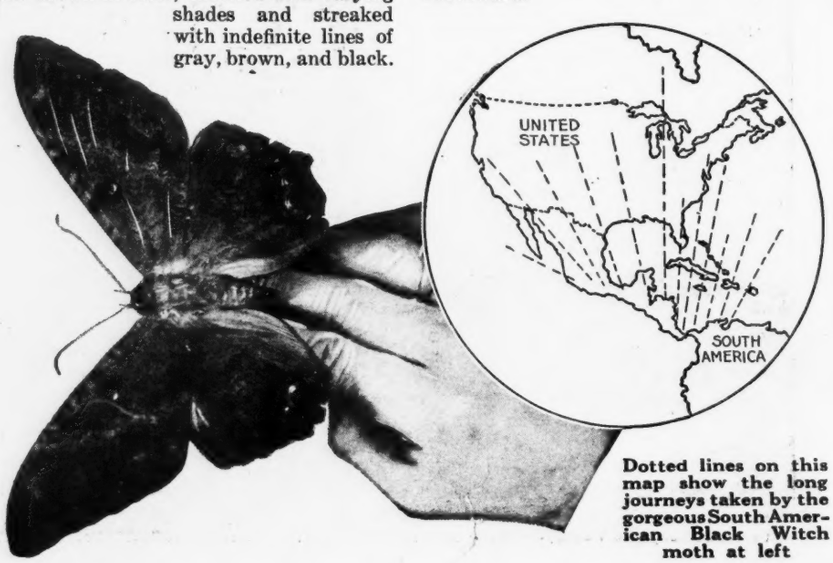
Fragile Moth Is World Wanderer

THE spirit of adventure was no stronger in Columbus, or in the wandering nomads of the desert, than in the mysterious Black Witch moth of the tropics, known scientifically as *Erebus odora*.

Breeding in South America, thousands of these moths become possessed with wanderlust, mount in the air to lofty heights and sail blindly into the vast unknown for thousands of miles.

The moths are large, with a wing expanse of from five to six inches. They are rich dark brown in color, mottled with varying shades and streaked with indefinite lines of gray, brown, and black. An incomplete "eye spot" adorns each wing.

The Black Witch's power of flight is almost unbelievable. Specimens found during late summer in the northern part of the United States show the effects of prolonged flight. Exhausted by continual buffeting by air currents and attracted by the glow of city lights, the moths come to earth at last, only to beat and break their wings against street lamps until they are but forlorn remnants of the beautiful creatures that started on the long journey northward.



Dotted lines on this map show the long journeys taken by the gorgeous South American Black Witch moth at left

Rotary "Telephone Book" Finds Numbers Quickly

THE business man who values his minutes will welcome a rotary index designed to save time lost in hunting through thick books to find a telephone number. A turn of the knob on this index brings the right number into view.

Within a fabric or leather covered case is a roll of paper with ruled spaces upon which one may write names and telephone numbers, a certain portion of the strip being allotted to each letter of the alphabet. Part of this strip can be seen through an opening in the case.

Pointer Does the Trick

A pointer at the top of the case moves backward and forward in a slot below which is a row of letters, A to Z. Both pointer and roll are connected with a knob at the side of the case. When the pointer reaches the letter that begins the name of the person whose number is sought, the desired telephone number appears in the exposed part of the roll.

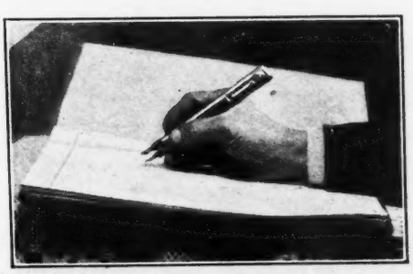
Four hundred names and numbers may be written on the index strip, which is 10 feet long. It is readily removable so that the names may be typewritten.

Turning the knob locates the number

Two Fountain Pens and a Pencil in One

DOING the work of a number of pens and pencils, a single writing instrument, recently invented, combines a blue-ink fountain pen, a red-ink fountain pen, a pencil, and an eraser.

Attached tubes hold two pens at one end and a pencil and eraser at the other. Each pen is slidably mounted, so that when pushed back, it slides out of the way of the pen that is being used.



Red and blue ink pens combined

Electric Scrubber Polishes Desks

Sandpaper, emery cloth, or other abrasive is inserted in a cylindrical plate in the bottom of this electric polisher, as shown above

FOR refinishing such as school desks, workbenches, chopping blocks, and table tops requiring smooth and sanitary surfaces, an ingenious electric sandpapering, polishing, and even a scrubbing machine recently has been perfected by a New York City concern.

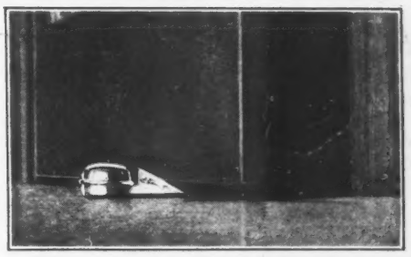
A one third horsepower electric motor turns a plate in the bottom of the machine at a speed of 208 revolutions a minute. To this spinning plate is attached the sandpaper, emery cloth, or other abrasive, the material used depending on the nature of the article being refinished.

Both wood and marble can be polished with this device. It is claimed that one machine can perform the work of 10 men.

Burglar Alarm Wedged under Door

WEDGED under the front door, a newly invented portable alarm provides an inexpensive yet efficient means of signaling the entrance of a burglar.

The alarm is equipped with a bell, spring, and wedge. After the door is locked, the wedge is placed loosely under it. If the lock is jimmied and the door opened, the spring is released and the bell rings. The bell continues to ring even after the door has been closed.

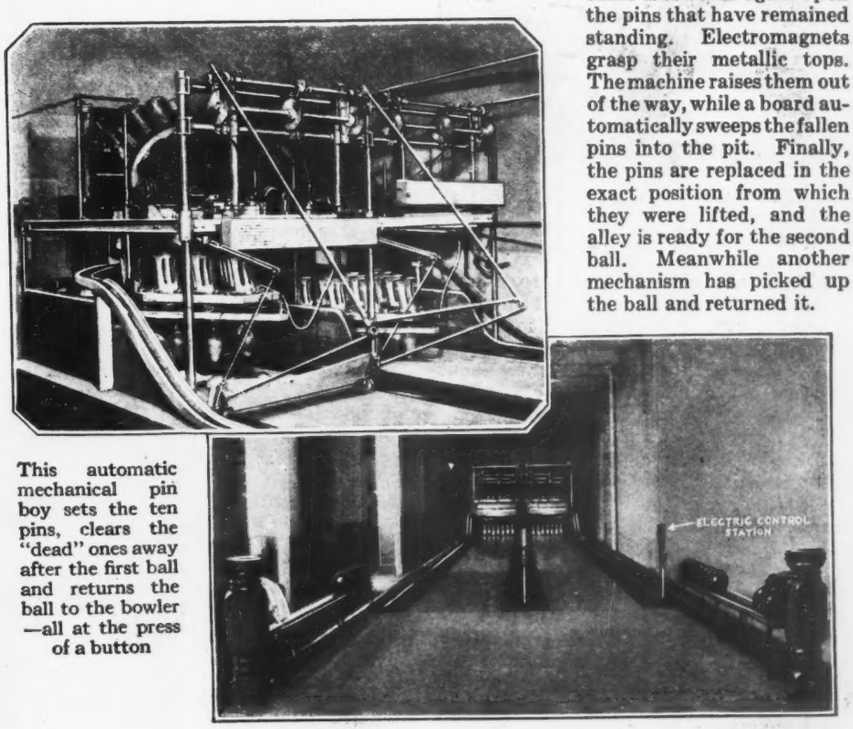


Bowlers Run Automatic Pin Boy

ALMOST human in its operation, a new automatic pin boy for bowling alleys not only sets up the pins, but clears them away after the first ball and returns the ball to the bowler within 15 seconds.

The machine is driven by electricity and uses 29 pins. Of these, 10 descend through holders and are placed. After placing the first set of pins, the machine is lifted off the alley by a bowler, who presses a button at the head of the alley.

After the first ball has been rolled, the machine is lowered again upon the pins that have remained standing. Electromagnets grasp their metallic tops. The machine raises them out of the way, while a board automatically sweeps the fallen pins into the pit. Finally, the pins are replaced in the exact position from which they were lifted, and the alley is ready for the second ball. Meanwhile another mechanism has picked up the ball and returned it.



This automatic mechanical pin boy sets the ten pins, clears the "dead" ones away after the first ball and returns the ball to the bowler —all at the press of a button

Harnessing a Geyser's Steam

Mirrors Guard Vault from

Midget Engine Pulls Seven

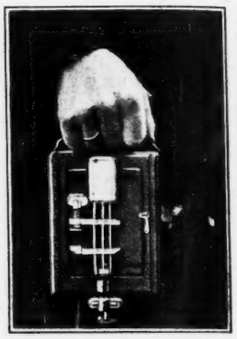
AMONG remarkable models exhibited recently at the Royal Horticultural Hall in London, was a small coal-driven locomotive able to pull seven people.

The engine was the work of J. C. Crebbin, a member of the Society of Model and Experimental Engineers. He claims that although it is only four feet long, it can draw four persons at a speed of 10 miles an hour.

The designer claims that a full sized engine built on the same principles would pull 50 per cent more weight with the same amount of fuel than present powerful railway locomotives.

Small Camera Clamp Serves as Tripod

A SMALL camera clamp that folds against the side of the instrument when not in use has recently been invented to eliminate the old cumbersome tripod.



The clamp frame is hinged to the camera and the clamp is adjusted by means of a thumbscrew. To take a time exposure it is necessary only to lower the clamp, fasten it to a post, small tree, or shrub, and the picture can be taken without difficulty. Because it folds into a small space the clamp can be used with a pocket camera without causing inconvenience.

What about the Weather?

EVERYBODY talks about the weather, but how many people know about it?

Do you know how tremendously a knowledge of weather conditions affects health, business, prices, weddings, and funerals?

In next month's issue—an unusual article by a famous government Weather Bureau official.

New Tool Trues Crankpin without Removing Shaft

AN INGENIOUS new tool to true up worn crankpins can be employed without removing the crankshaft from the engine. It consists of a rigid circular frame that carries a cutter and is turned about the shaftpin by means of a lever.

To true the pin of a shaft, the lower half of the crankcase is removed and the connecting rod is disconnected and pushed up into the cylinder. The tool is then applied by loosening a swing bolt and opening the frame. Within the frame is a cutting tool that cuts any grooves down flush and when dull can be removed from the frame.

On the outside of the frame are a number of holes into which a lever can be successively inserted for turning the tool about the crankpin. The holes are sufficiently close together so that the cutter can be turned even in the cramped space within the crankcase.

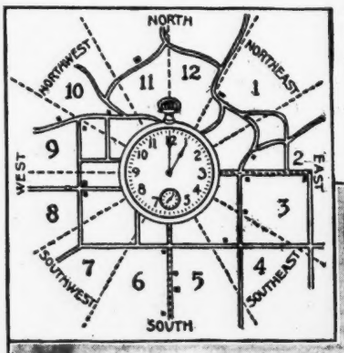
Rural Districts Mapped by the Clock

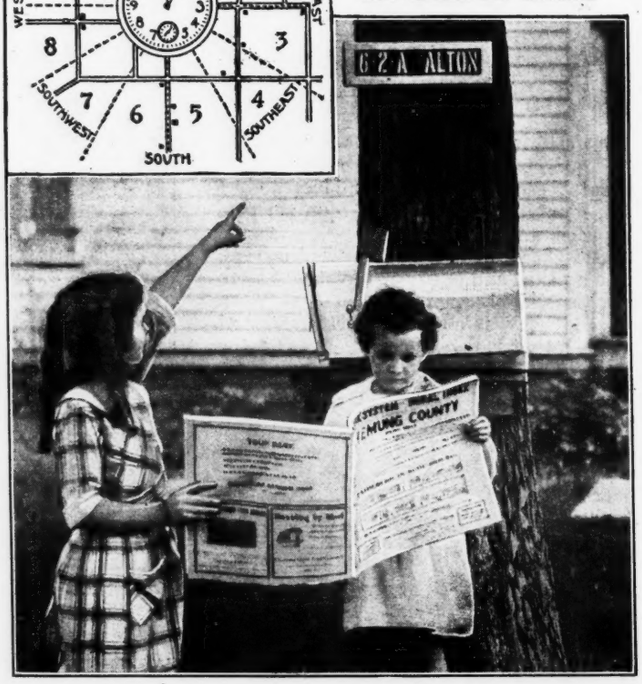
TO MAKE every rural homestead a guide to automobile tourists and to facilitate merchandise deliveries, a simple numbering system has been perfected. A clock number signboard with the name of the nearest town is used to locate any residence in a scattered community. All that is required is a watch, the approximate distance from a known center, and a knowledge of the points of the compass.

Each character used on the clock number signboard has a definite meaning. The first tells the direction of the farm from the town used as a center; the second the distance from the town, and the third the individual letter of the owner. Following these characters the name of the town used as a center is printed.

Twelve o'clock on the watch is due north from the given center, and six o'clock due south. Each hour divides the neighboring countryside into a direction sector.

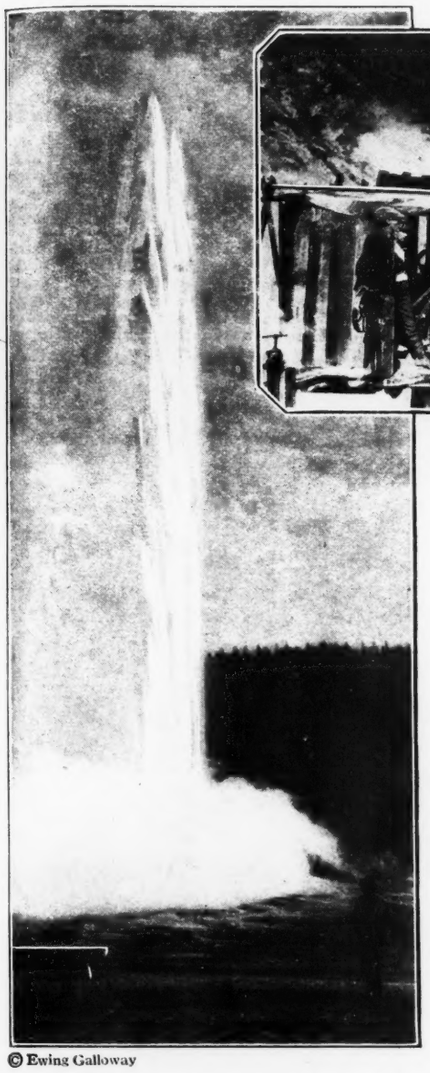
Suppose Peter Smith, who lives two miles south of Alton, is sought. The town directory says that Smith's address is "6-2-A Alton." Taking the road running south, the first house two miles out should be the home of the person sought. The second house, six miles from Alton, would be numbered "6-6-B Alton."

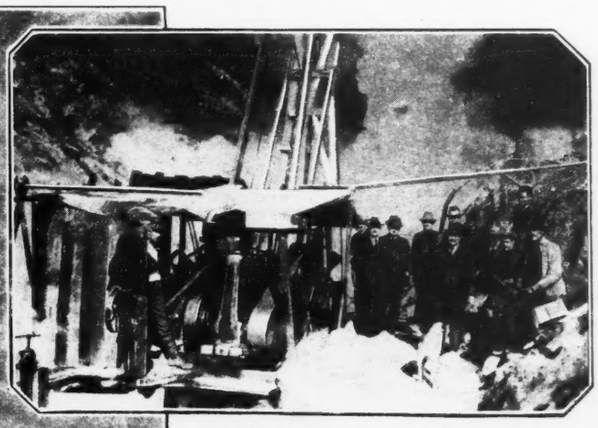




At the left, a clock map of a community. Below, how homes are lettered

Harnessing a Geyser's Steam





"Old Faithful" geyser in the Yellowstone National Park and, above, the engine used to develop 1500 horsepower from steam vents in Geyser Canyon, Calif.

© Ewing Galloway

NOT satisfied with harnessing winds, rivers, and even volcanoes, man at last has succeeded in putting to work another of nature's wonders—the geyser. Today in Geyser Canyon, Sonoma County, Calif., an engine is delivering 1500 horsepower from steam taken directly from a geyser.

The feat was accomplished after 10 years of experiment by John D. Grant, of Healdsburg, Calif., who believes the harnessing of geysers may eventually supply electric power to his state at a remarkably low cost. In making use of volcanic steam, he is following the lead of Italian engineers who now are boring for steam in the flanks of Vesuvius and Etna.

Grant obtains steam for his power by driving a hole about 2½ inches in diameter into the throat of the fissure from which steam issues. The hole is driven at an angle of about 60 degrees and from 75 to 100 feet from the mouth of the geyser. Drilling is done with a rotary drill, a two-inch pipe closely following the drill.

At the surface end of the two-inch pipe line a cap with an exhaust tap and a safety valve is screwed down. An inch pipe line connects this cap with the engine. The power thus derived is now being used to drill other holes.

Engineers estimate that approximately 1,500,000 horsepower may be produced by geysers in this canyon alone.

Mirrors Guard Vault from Tunneling Safe Crackers

SAFE crackers will never visit a new $75,000 bank vault in Hollywood, Calif., because they never will be able to reach it undetected!

The vault is located in the basement of the bank. Instead of being embedded solidly in concrete or masonry, it is set on concrete piers, leaving an open area beneath. In a gallery extending entirely around the vault mirrors are placed in such a way that they reflect the well-lighted area under the vault. Mirrors are also placed at the corners of the galleries so that a watchman in one passage can see what is going on in the others.

The vault is of concrete and steel, lined with hardened steel, more than 110 tons of the metal being used in its construction.

How mirrors reflect the lighted area under the vault

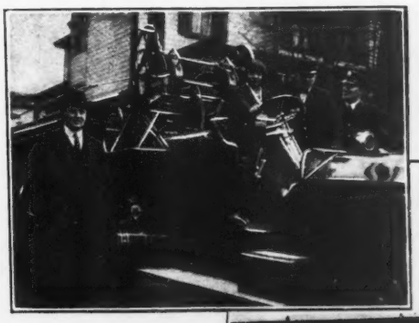
Engine Exhaust Operates Automobile Air Brakes

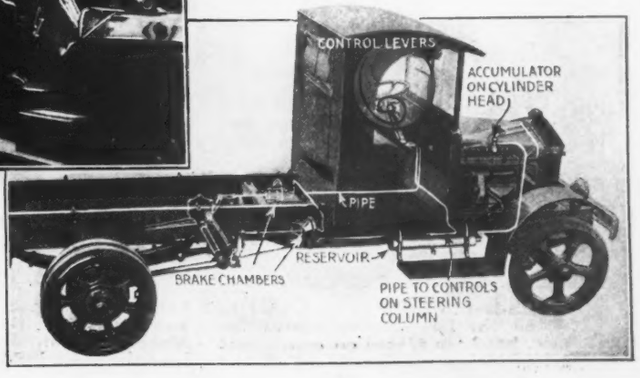
A NEWLY developed air brake for automobiles, proclaimed a success after a truck equipped with the apparatus was driven from Chicago to New York, is hailed as one possible solution of the problem of automotive braking. Just as the pneumatic brake made possible great speeds and sure stops on trains, it may eliminate many accidents now caused by faulty foot brakes.

Pressure is obtained by tapping one of the engine cylinders. An accumulator attachment with a ball valve takes off some of the burned gases and delivers them to a reservoir. When a pressure of 75 pounds is reached in this reservoir, no further gases are admitted. In proportion to the amount of gases burned, the amount used for pressure is said to be so small as to cause no noticeable effect on the running of the motor.

From the pressure reservoir the gases are led through pipes to a control valve at the wheel. By turning a handle, the driver can apply any desired pressure to the brakes. The farther the handle is turned, the more force will be exerted on the pistons in the brake chambers. These brake chambers are located in front of each wheel and their pistons are connected with rods that operate levers connected with the brake drum.

An air brake system, it is said, can be installed on pleasure cars as well as trucks without disturbing the hand and pedal arrangements already installed. In fact, the regular emergency brake is retained to prevent accidents due to possible faulty operation of the pneumatic brakes.

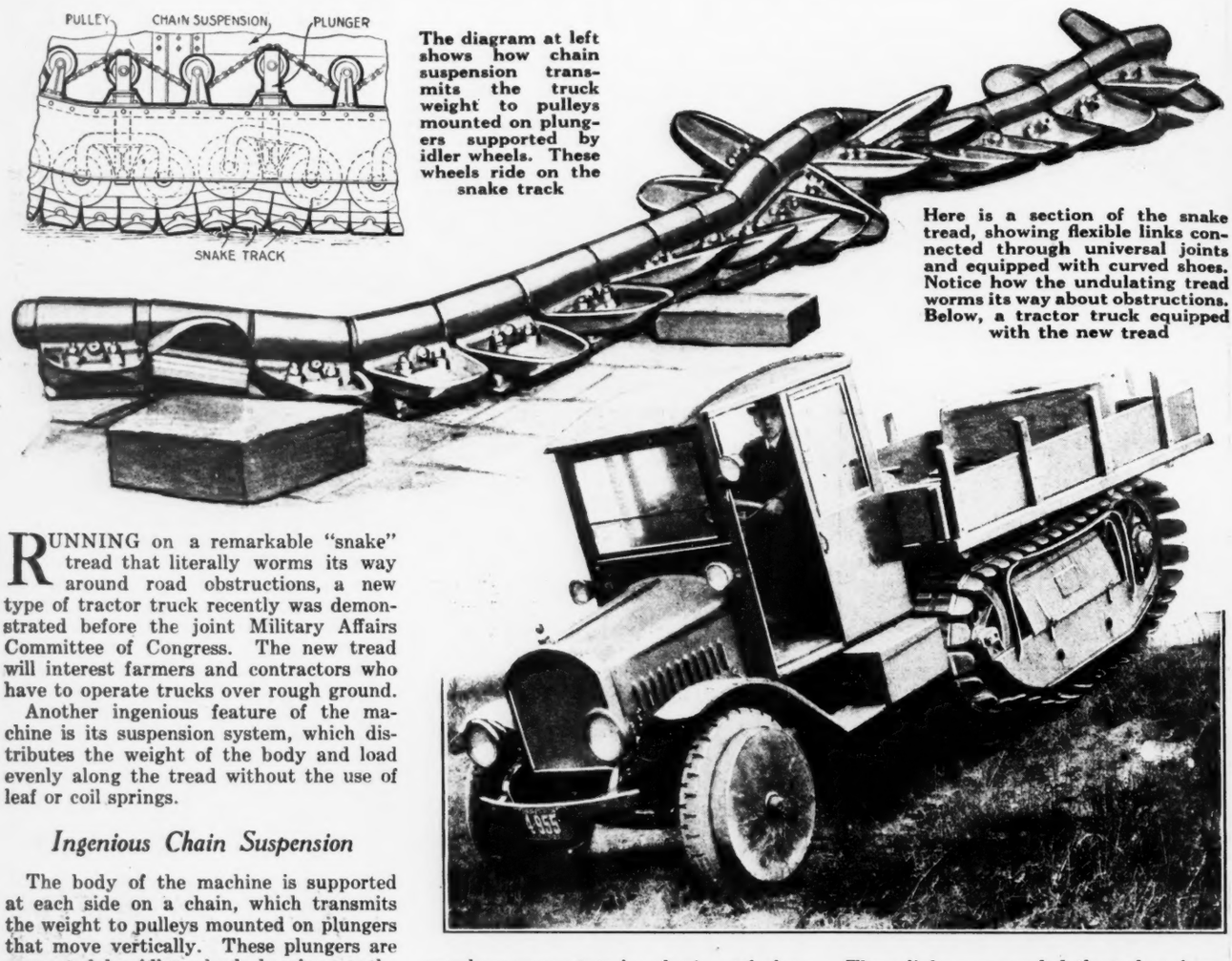




Above: A heavy fire engine at Wilkinsburg, Pa., equipped with air brakes and easily controlled by a girl. At the right: How the air brake apparatus is installed

New Snake Tread Conquers Bumps

The diagram at left shows how chain suspension transmits the truck weight to pulleys mounted on plungers supported by idler wheels. These wheels ride on the snake track



Here is a section of the snake tread, showing flexible links connected through universal joints and equipped with curved shoes. Notice how the undulating tread worms its way about obstructions. Below, a tractor truck equipped with the new tread

RUNNING on a remarkable "snake" tread that literally worms its way around road obstructions, a new type of tractor truck recently was demonstrated before the joint Military Affairs Committee of Congress. The new tread will interest farmers and contractors who have to operate trucks over rough ground.

Another ingenious feature of the machine is its suspension system, which distributes the weight of the body and load evenly along the tread without the use of leaf or coil springs.

Ingenious Chain Suspension

The body of the machine is supported at each side on a chain, which transmits the weight to pulleys mounted on plungers that move vertically. These plungers are supported by idler wheels bearing on the snake track.

The lower end of the plungers bear on cross members in such a way that these members may rotate in a horizontal plane, thus providing for extreme flexibility.

The snake track itself is made up of a series of links to which shoes are attached. These links are coupled through universal joints and thus are allowed wide latitude in movement. Each link of the track contains a reservoir of oil.

The World's Largest Lump of Coal

THIS 10-ton lump of coal, said to be the largest ever mined intact, has been placed on permanent exhibition in the basement of the Utah state Capitol. It is 10 feet long and five feet high and was mined at Mohrland, Utah. The picture shows how the great lump was moved

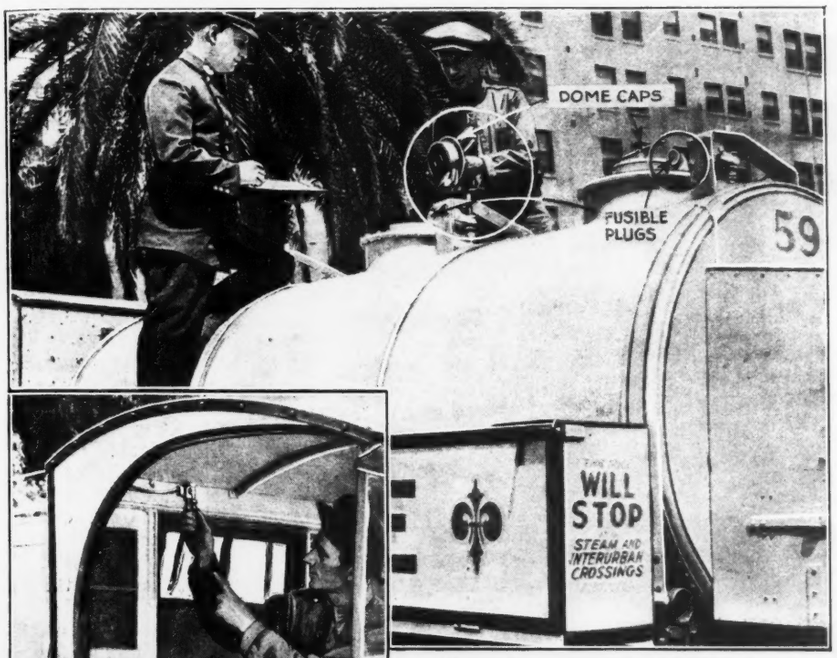
Open Nation-Wide War on Deadly Diphtheria

REMARKABLE results obtained by the New York Health Department in stamping out diphtheria during the past three years by the use of diphtheria bacteria as an antitoxin, have encouraged those in charge of the work to launch a nationwide campaign to rid America of what once was its most dangerous child disease.

During the past two years in every city in America, except New York, where the so-called Schick test has been used extensively, the average number of cases of diphtheria in the United States for the 10 years ending 1920 was 132,000. In 1921 this number suddenly increased to 149,000, and in 1922 to 209,000. During the same period the number of cases in New York City decreased and the diphtheria death rate was reduced from 22 in every 100,000 persons in 1919 to 16 every 100,000 in 1921.

The Shick test is applied by vaccinating a child's arm with a solution containing minced microbes of diphtheria. If the skin at the site of injection remains normal, it indicates that the child is already protected by nature against diphtheria. But if a trace of redness appears from 12 to 36 hours after the "vaccination" and there is a distinct bodily reaction, it shows that the child is not immune.

A Fireproof Gasoline Truck



Above, dome caps with fusible plugs to permit escape of gasoline fumes under intense heat. At left, the tripper by which the driver from his seat can close the valves in case of fire

THE increase in the number of fires due to gasoline has led a Los Angeles oil concern to complete a tank truck said to be absolutely explosion-proof.

The new truck has been pronounced the safest on the streets of Los Angeles by Fire Chief Todd. It has three compartments, each of which is equipped with a dome cap in which is a plug of fusible metal that melts at a temperature of 185 degrees. In case the car is in a burning building, these plugs will melt, permitting the fumes of the heated gasoline to escape. A metal screen in the dome will prevent the flames from entering the tank.

The arrangement is similar to a miner's safety lamp where the gases entering the lamp can burn, but the flames cannot pass out through the screen that surrounds the lamp.

Should a fire occur at the rear of the truck, a fusible link in a chain will melt, causing all valves to be automatically shut off.

The opening of the rear door short circuits the current for the engine and thus prevents driving away without shutting the gasoline valves and the door.

Novel Typewriter Built in Units

AN INGENIOUS demountable typewriter recently perfected permits the use of carriages of varying lengths on a single machine, and the interchanging of the parts of several machines. Easy disassembling provides a ready means of cleaning the working parts.

By pulling out a locking member, the frame of the typewriter can be lifted from the action unit, exposing all working parts. By releasing two catches, the carriage and rails can be removed and longer rails and a longer carriage substituted. Thus a single machine will suffice to type wide charts and ledger sheets as well as ordinary letters. Should one part of a machine become worn out, a new part can be substituted easily.

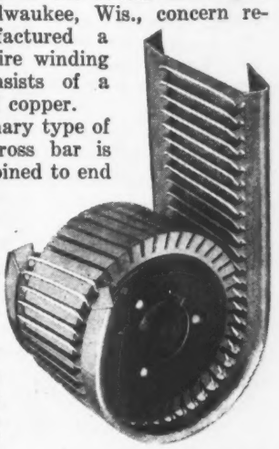
The new invention is designed to provide a time and money saving accessory for the up-to-date office.

The knockdown typewriter, showing (at left) how the carriage is easily removed by releasing two end catches, and how the frame of the machine is lifted from the action unit, exposing working parts

Rotor Winding Formed of Single Copper Sheet

TO ELIMINATE the loosening of the cross bars in the rotors of electric motors, a Milwaukee, Wis., concern recently manufactured a rotor, the entire winding of which consists of a single sheet of copper.

In the ordinary type of rotor, each cross bar is individually joined to end rings, thus making a number of joints that often have a tendency to loosen.

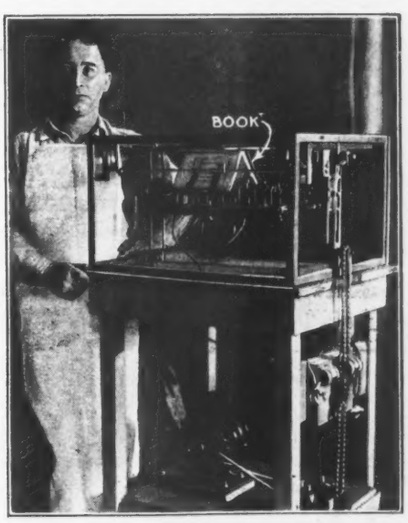


Rotor winding cut from one piece of copper

In the new rotor the entire winding consists of a single sheet of copper punched across in such a way as to form a series of protruding segments. These segments are twisted so that when the winding is wrapped around the core, they will fit into the rotor slots.

After wrapping, the two loose ends of the copper sheet are silver welded and the joint is then rehardened to restore the copper that has become softened in the welding process. The sheet is machine wrapped.

Machine Fumigates Leaves of Books Automatically



SALVAGING books that have been exposed to contagious diseases may be possible soon as a result of the recent invention of a book fumigating machine by R. Oldham, of Salt Lake City, Utah. This machine automatically exposes the entire book, page by page, to the action of germ killing fumes.

A book is dropped through a trapdoor in the top of the fumigating box, in such a way that the two covers of the book rest upon supporting lugs, allowing the leaves to hang suspended against operating rollers. The entire box is then filled with fumes and the operator, by turning a crank, sets the machine to the proper size and causes the leaves to be moved from one cover to the other until all have been separated. Thus the fumes completely penetrate the book.

DUST—Where It Comes From

IN EVERY cubic inch of air breathed by persons on the Eastern coast, there are all the way from 5000 to 49,000 particles of dust. Uncle Sam's Weather Bureau has just counted them.

Our atmosphere is always loaded with dust. Without dust to reflect sunlight we should have no gorgeous sunsets, no twilights, no scenic mountain hazes. Without dust there would be almost no clouds, for dust particles form the centers about which moisture in the air condenses.

Where does all the dust come from?

Its most spectacular source is the duststorm, in which the soil of dry lands, picked up by high winds, is carried overland for miles. Scientists have just discovered that in the "Great Dustfall of 1920," 2,000,000 tons of Colorado, Wyoming, Kansas, and Nebraska soil was lifted thousands of feet, carried eastward by a terrific windstorm, and deposited in the region of the Great Lakes and the St. Lawrence drainage system. It fell in the form of dust particles during a snowstorm that lasted only two days!

Imagine a freight train of 40,000 cars, each of 50 tons capacity, and all of them loaded with dust, and you have an idea of the enormous quantity of grit that fell in that two-day storm.

These astounding facts have been revealed in what probably is the first analysis of its kind in America, made by Professor Eric R. Miller and A. N. Winchell of the University of Wisconsin.

In the city of Madison, Wis., the dust deposit averaged about 28 tons to the square mile, an amount that would fill 280 ordinary automobile trucks. The particles were so small that they could not be seen with the unaided eye.

Sweeping over Colorado and Wyoming, the destructive wind in some places attained a velocity of 74 miles an hour. Whirling snow, dust, and sand halted trains in Colorado. In two days the storm reached the Great Lakes region, prevailing as far south as Little Rock, where dust sifted into offices, covering everything. The haze was observed as far east as Nashville, Tenn., and Columbus, Ohio.

This dustfall is said to have been the greatest of its kind ever recorded.

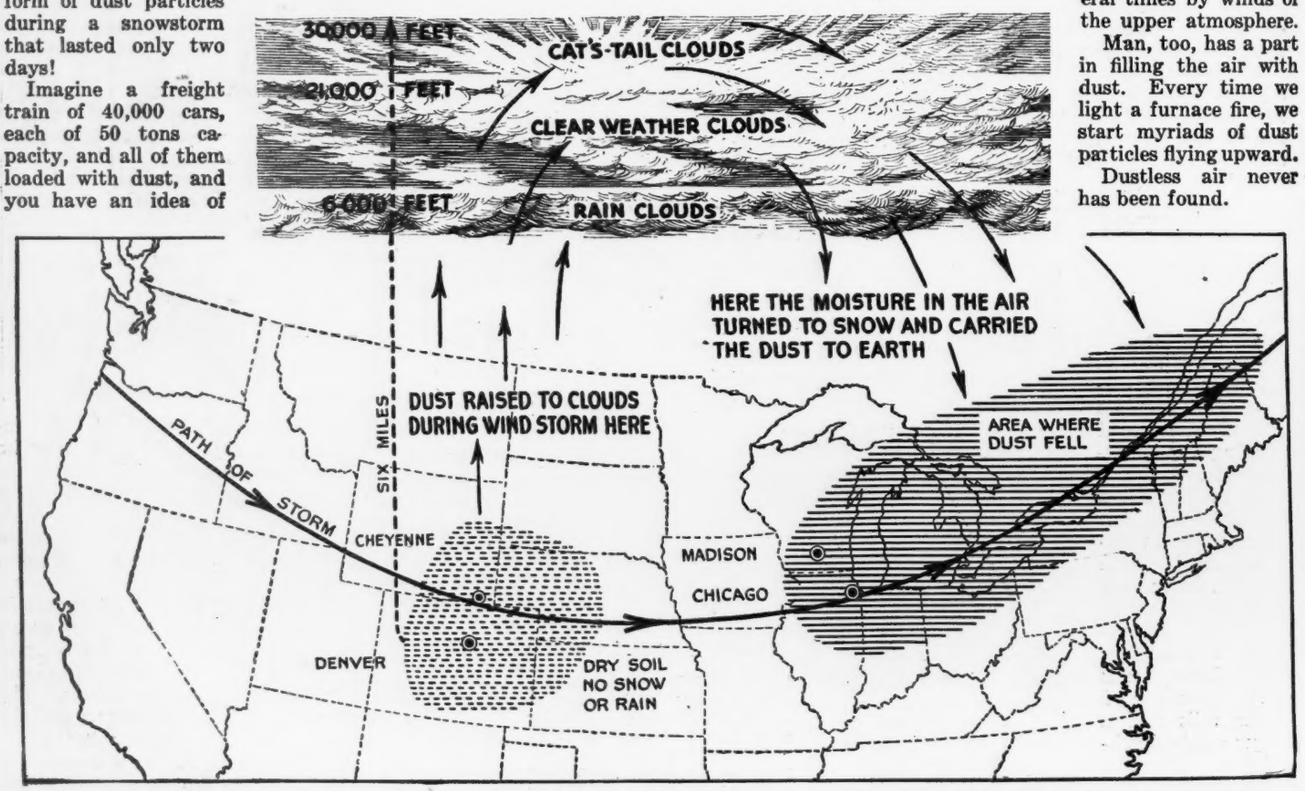
Volcanoes are another source of the dust in our atmosphere. The great Krakatoa eruption near the island of Java in 1883, for example, hurled fine dust 80 miles into the air, to be carried around the earth several times by winds of the upper atmosphere.

Man, too, has a part in filling the air with dust. Every time we light a furnace fire, we start myriads of dust particles flying upward.

Dustless air never has been found.

© Ewing Galloway

A gorgeous sunset such as this is made possible by dust particles in the atmosphere, reflecting sunlight. Without dust we should have no twilight



This map explains the "Great Dustfall of 1920." Picked up from Western plains by a terrific windstorm and carried thousands of feet into the air, the dust was whirled eastward with the clouds, and finally dropped to earth with a snowfall

Yucatan—Egypt's American Rival

Scientists Seek to Decipher Lost Maya Language

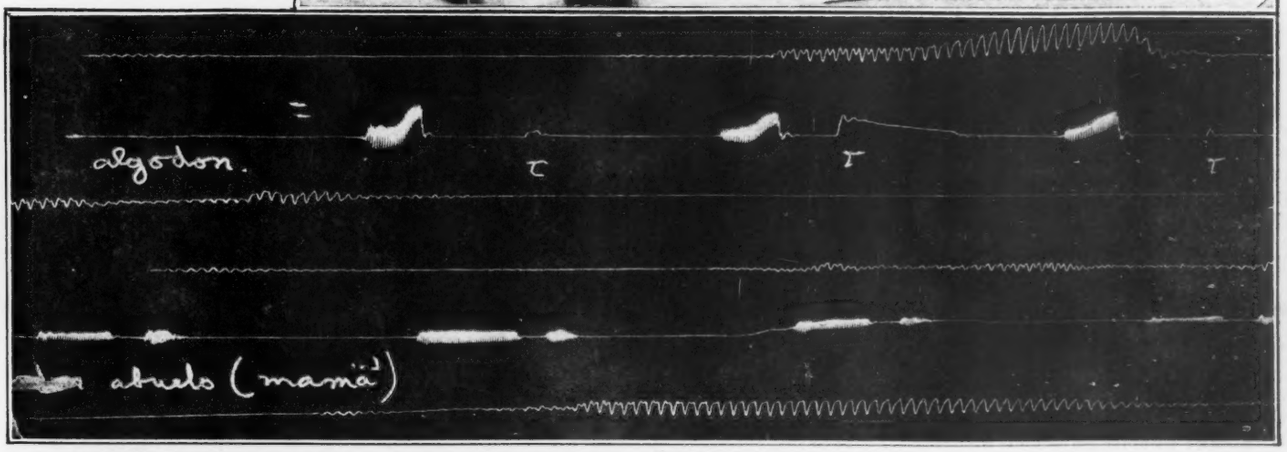
DIGGING in the ruins of two long-forgotten cities on the Yucatan peninsula of Mexico, American archeologists expect soon to unearth secrets of a remarkable ancient Maya civilization that flourished on the American continent hundreds of years before the Christian era, surpassing in importance the recent discoveries in the Valley of the Kings in Egypt. Meanwhile, Dr. William Gates, president of the Maya Society, is conducting a search for the key to the ancient Maya picture writings.

Egypt's archeological rivals are the cities of Usmal and Chichen-Itza. Curious stones, clay figures golden bells, weapons, and chairs are plentiful, giving evidence of an older civilization than that of Luxor

AT THE right is a model restoration of what is believed to be an ancient Maya temple unearthed in the ruined city of Chichen-Itza, Yucatan. Notice the pyramid construction of the massive foundation and the highly developed architecture, especially in the form of the arches. This model stands in the American Museum of Natural History

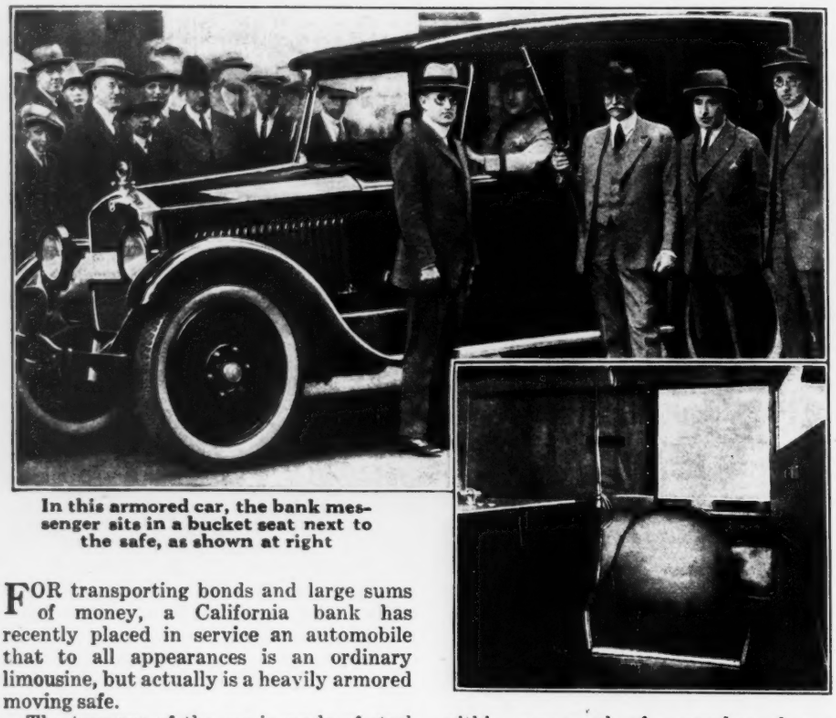
Center photo © Harris & Ewing

ATTEMPTING to decipher ancient Maya picture writings, Dr. William Gates, president of the Maya Society, is shown at the right analyzing the speech of a full blooded Quiche Indian, a direct descendant of the Mayas. In the instrument, known as a "kymograph," the Indian's voice sounds pass through tubes connecting his mouth and nose with styluses. These produce wave writings on a revolving smoked paper cylinder



Typical wave writings of the spoken words of the Quiche Indian, as recorded by the kymograph, above. Each line pictures the variations in voice vibrations in speaking a word. Each word is stretched out for study at about 16 inches a second. By these word-graphs Doctor Gates hopes to discover the long sought key to the Maya language

Bank Has Armored Limousine



In this armored car, the bank messenger sits in a bucket seat next to the safe, as shown at right

FOR transporting bonds and large sums of money, a California bank has recently placed in service an automobile that to all appearances is an ordinary limousine, but actually is a heavily armored moving safe.

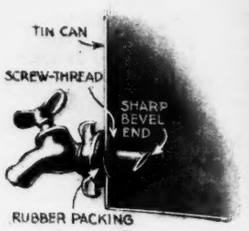
The tonneau of the car is made of steel plates that will resist rifle and pistol bullets. Only one entrance is provided. What appears to be a door on the left side, where robbers naturally would attempt to enter, is a decoy.

In the place usually taken up by the rear seat is a built-in safe. The bank messenger sits on a small seat in front of the safe within easy reach of a number of armor protected portholes through which he can fire at any assailants. The glass used in the body is made of bullet proof glass.

Should anything happen to the chauffeur, the messenger within can still control the car by means of secret switches located in front of his bucket seat. A separate brake system is also provided for his use.

Solderless Faucet for Oilcan Easily Made

SOME years ago H. B. Killefer, of Los Angeles, Calif., was filling a lamp from a five-gallon can of kerosene. The result was, as usual, some oil in the lamp, some on the outside of the can, some on the floor, and a little on his clothes. He decided that if a faucet could be invented that could be attached to a can when full, it would save a great deal of time and oil.



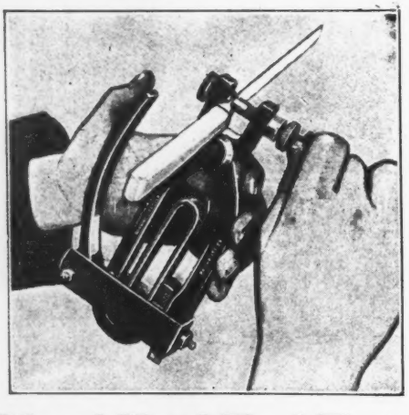
How faucet is inserted in can

A letter-file in which the paper was neatly punched by means of a bevelled point gave him an idea. Could a tin can be perforated by the faucet itself?

After experimenting with a good many models, he found a bevel that cut the tin neatly and quickly, and that might readily be sharpened by filing its edge.

He placed a spiral flange on his cutter, and the rough places on the perforation acted as a screw-thread by means of which the flange could be forced inside the can. Next to the flange was a rubber washer, and outside that a nut, by which the washer could be tightened against the exterior of the tin. This makes the solderless faucet tight even against gasoline.

It is claimed that several oil companies are adopting the device.



Novel Hand Tool Tests Hardness of Metal

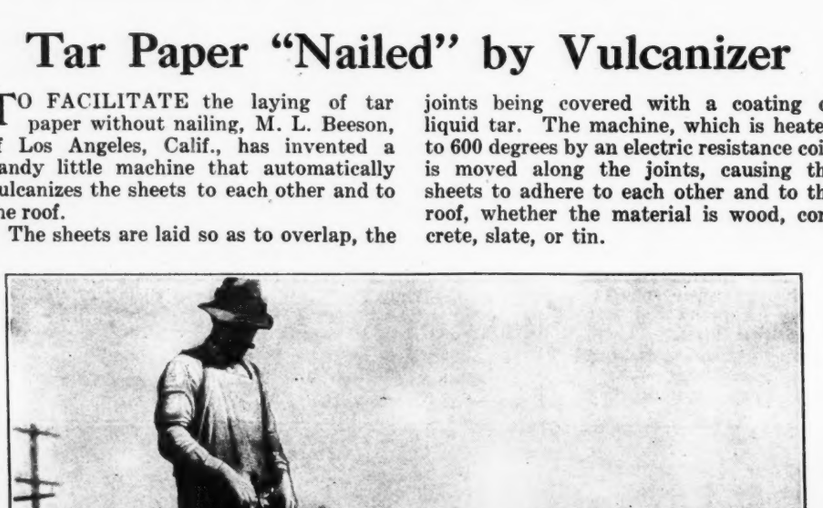
A HANDY new portable tester for determining the hardness of metals used in industries is a miniature of the standard tester. In it a steel ball is forced against the surface of the material under test, producing an indentation, the area of which is an indication of the degree of hardness.

One of the jaws of the instrument is equipped with an anvil, while the other has a rigidly fastened ball of 3/32-inch diameter. When a lever above one of the pincher arms is depressed, these jaws are brought together by the hand power transmitted through a regulating spring. While the lever bears directly on one arm, the spring bears on the other. This is necessary since the pressure on the material under test must be constant.

Tar Paper "Nailed" by Vulcanizer

TO FACILITATE the laying of tar paper without nailing, M. L. Beeson, of Los Angeles, Calif., has invented a handy little machine that automatically vulcanizes the sheets to each other and to the roof.

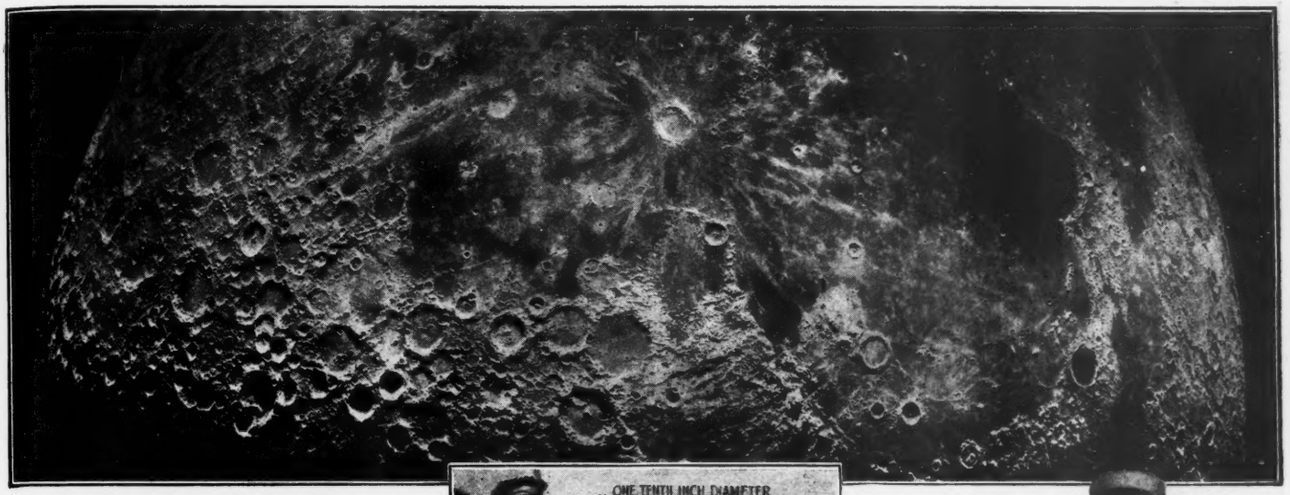
The sheets are laid so as to overlap, the joints being covered with a coating of liquid tar. The machine, which is heated to 600 degrees by an electric resistance coil, is moved along the joints, causing the sheets to adhere to each other and to the roof, whether the material is wood, concrete, slate, or tin.



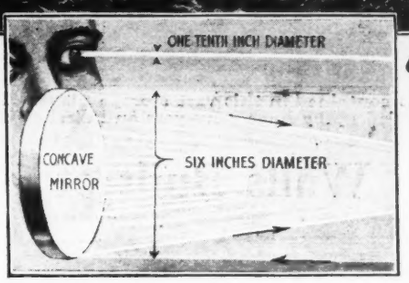
Heated by an electric resistance coil, this vulcanizer passes over joints of overlapping sheets of tar paper, fastening them to each other and to the roof

Homespun Astronomy

Amateurs Can Build "Stove Pipe" Telescopes



How the craters of the moon appear in the "big eye" of a powerful telescope



A telescope is really just a big eye. While the pupil of an unaided eye receives a beam of light only one tenth of an inch in diameter, the concave mirror of a six-inch reflector gathers in a beam 2500 times greater

HOMESPUN astronomy for us all. That's the aim of a little group of industrial workers in Springfield, Vt., who have just succeeded, where experts have failed, in bringing the fascinating science of the heavens down to earth and popularizing it.

It has remained for these 14 men mechanics and one woman stenographer to drag the wonder-revealing reflecting telescope out of exclusive observatories and to make it available on every hilltop.

They have done it by conquering the greatest obstacle in the way of amateur astronomy—the telescope. A powerful astronomical telescope is a costly instrument. Modern manufacturing methods apparently have been unable to bring it within the means of the average man.

"All right, then," said these folks from the Green Mountain state; "we'll make our own telescopes." And they made them —strange instruments that look like stove pipes, water pipes, and dishwashers.

But the blamed things work!

Today the 15 would-be astronomers, ranging in age from 19 to 67, and most of them boasting a district school education, are unlocking the mysteries of the heavens with homemade tools!

Here's how it came about:

Three years ago Russell W. Porter, an astronomer, returned to Springfield after an absence of many years devoted to astronomical work in the north polar regions. He found many of his old friends interested in his work. They wanted to know something about the mysteries of the heavens. But they had no instruments.

"Let's make them," said Porter.

The president of one of the city's large industries, an amateur astronomer, added encouragement by turning over to them part of a basement in one of his buildings for a workshop. Under the direction of Mr. Porter, the 15 fledgling astronomers worked night after night, grinding mirrors and mounting their instruments.

The principles of the Newtonian reflector were pictured on the blackboard and explained by Porter like this:

" 'Telescope' sounds too highbrow. Let's call our instruments the 'big eyes.' For, after all, a telescope is nothing more than a great big eye—a concave mirror fastened to a board—to help us see distant objects."

The mountings devised for the "big eyes" were ingenious. Some of the men made their stands from barrels filled with sand or castings; some used boxes; still others made wooden pedestals.

Grinding the reflecting mirrors was accomplished slowly by rubbing two pieces of plate glass together. The top piece of glass gradually became concave and the bottom convex. Delicate measurements were made with painstaking exactness.

© U. & U.

A stove pipe? Guess again. This strange looking instrument is a powerful homemade telescope, shown with its creator, Oscar Marshall

The mirrors range from five to 10 inches aperture with focal lengths of about eight times the diameter. The complete instruments cost less than $30 each.

Completion of the instruments was just the beginning in the telescope makers' interest in astronomy. There followed nights of exploration, when they would camp on some mountain top to get a close-up of moon and stars.

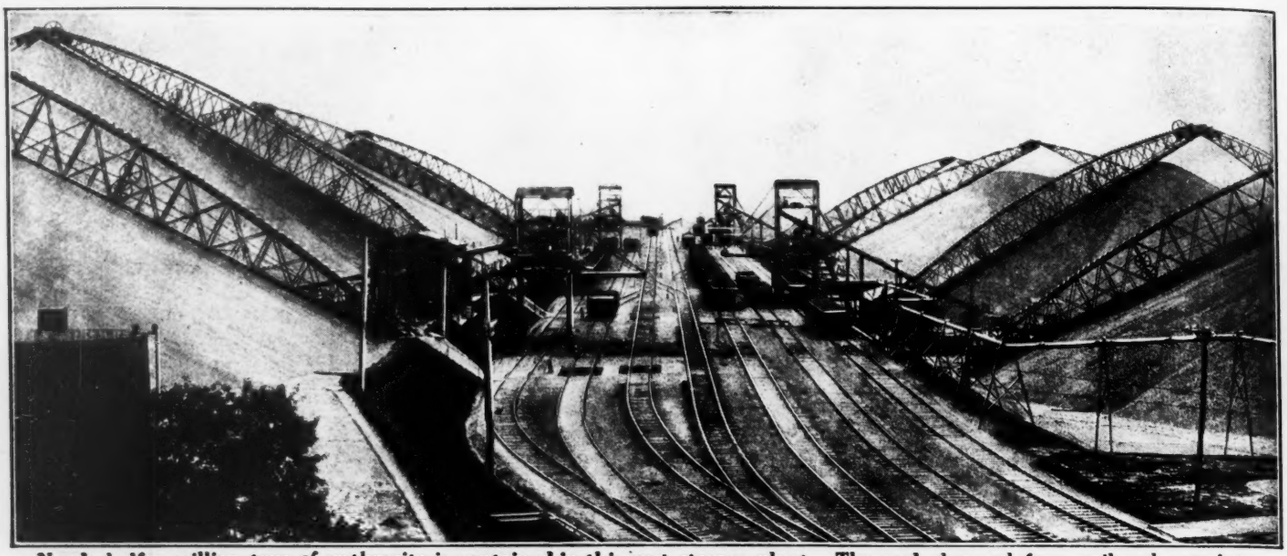
Homespun astronomy —that's their hobby. They tell the world it's a science of wonders, available to any man who will jump technical barriers.

Springfield telescope makers assembled at the top of one of the Green Mountains for a night of exploring the heavens

At left: A six-inch reflector made by a Springfield woman

Oddities in the News

Storing Half a Million Tons of Coal



Nearly half a million tons of anthracite is contained in this vast storage plant. The coal, dumped from railroad cars into receiving hoppers beneath the track, is carried up by huge conveyors and discharged at the top of the continually rising piles

Amateur Camera Men Can Make Their Own Movies

MOTION pictures said to be equal in quality to those seen in theaters can now be taken and projected by amateurs in their own homes. A well known manufacturer has just announced the perfection of a complete movie outfit for amateurs consisting of an inexpensive motion picture kodak almost as simple in operation as the ordinary camera, and a projector for home use.

Sixteen Pictures a Second

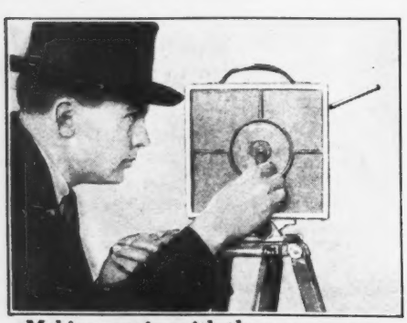
The camera weighs only seven pounds. Its special lens enables photographs to be made under poor lighting conditions. It will take 16 pictures a second.

The film for the new movie outfit is much smaller than standard films. Four hundred feet of it is equivalent to 1000 feet of standard reel. It is non-inflammable, and therefore safe to use in homes and schools.

A coating of special emulsion permits a direct positive to be made from the film, thus effecting a great reduction in cost. Films after exposure are sent to the kodak company for development.

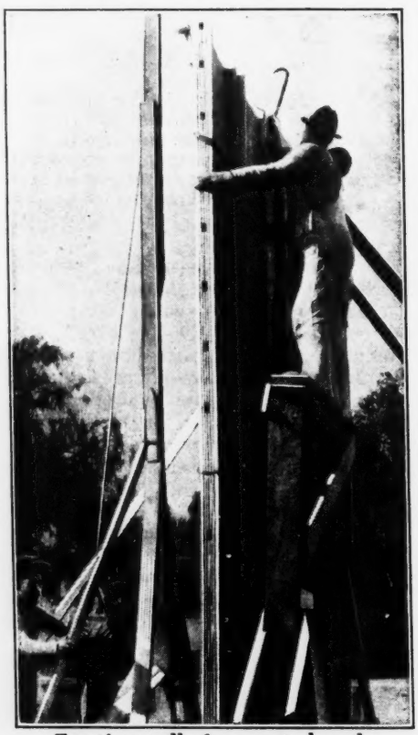
Motor driven, the projector that throws the pictures on the screen is automatic in operation, the only attention necessary being the threading of films on the machine. A 400-foot reel lasts for 16 minutes.

Arrangements are being made to reduce standard films for use in the projector so that professional as well as amateur pictures may be shown in the home.



Making movies with the new camera

Walls Built of Concrete "Lumber"



Erecting wall of concrete boards

A NEW kind of concrete "lumber" now manufactured in southern California, is being used successfully to replace wood for building.

The standard size of a board of this type is 24 inches in width and 8½ feet long. Each board has a three-inch concrete studding along each edge to be used in joining. The outer edges of the studs are grooved so that they will mesh tightly with each other when shackle bolts are fastened through the holes. These holes occur every foot along the studs.

"Board" Has Steel Core

Boards and studs are cast together in a single form. Each board is reinforced by a frame of welded steel wire and in the center of the stud is a one-quarter-inch deformed steel bar to which the wire is fastened. This frame is placed in the form, concrete is poured around it, and tamped in place. The top surface is then smoothed off and the "boards" are allowed to cure for 20 days.

In erecting walls, the joining bolts can be utilized to hold wooden strips to which laths may be nailed. Floors are laid by placing the boards horizontally.

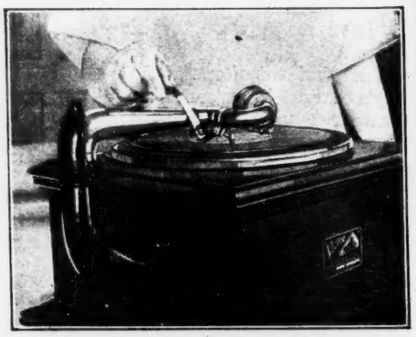
This new material has been found especially adapted to the erection of small buildings, such as garages.

New Starter Saves Disk Records

A STARTING lever for phonographs, which can be adjusted to fit any type of machine using disk records, has recently been invented by E. W. Cornell, of Adrian, Mich., to provide a means of lowering the needle upon the record mechanically without injuring either.

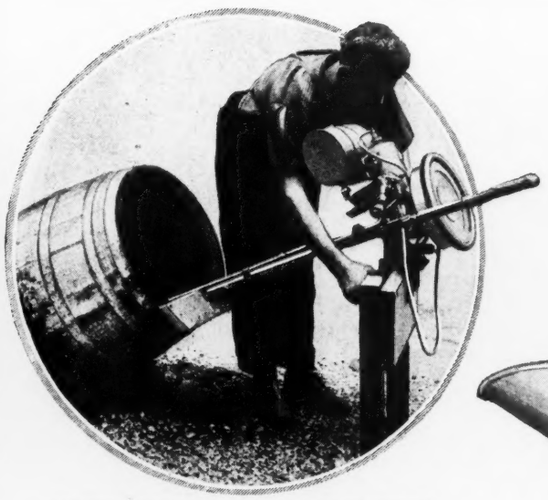
When the lever is pushed back, a cam operates to raise the sound arm so that the needle point will clear the record by about half an inch.

When the starting lever is moved forward, the leverage thus obtained permits slow lowering of the needle, thus preventing a careless operator from scarring the record.



Lever is screwed to sound arm

Oddities in the News



TESTS MOTOR IN WATER BARREL

How a resourceful salesman in Detroit, Mich., uses a water barrel as a substitute for a lake in demonstrating the performance of an outboard motor for power rowboats or canoes. Partly filling a barrel with water, he tilts it in a slanting position. Then he attaches the motor to a frame in such a way that the propeller revolves in the water

STUDENTS LEARN HOW TO "MOTHER" BABIES

Modern girl students are learning by practice how to be good mothers. This healthy baby, Jean Christie, is thriving under the mothering of young co-eds specializing in home economics at the State College, Brookings, S. D. The college has established a "baby laboratory," where the student applies her classroom learning in child care, child psychology, home management, and infant feeding by actually taking charge of a house and real baby.

Baby Jean has six "mothers" a term—that means a new one about every 14 days

THE ONLY BLACK FACED LION KILLER IN CAPTIVITY

This ferocious black-faced drill, first of its kind ever captured, is one of the few animals that dares attack a lion. He was brought to Philadelphia recently from West Africa

WHERE TROLLEY CAR SERVES AS FIRE TRUCK

A novel "fire trolley car" takes the place of a fire truck in protecting the homes of Park Point, a thickly settled island near Duluth, Minn. Since the trolley line extends 12 miles through the center of the narrow island, all buildings are within easy reach. When an alarm rings, a fireman-motorman runs the car out of the barn and picks up volunteer firemen along the line

Sky Police Force to Run Crime Planes to Earth

By Fiorella La Guardia

Congressman-elect from New York City and former Colonel of Aerial Police Reserve

From his point of vantage high in the air, the aerial policeman of Venice, Calif., "spots" a criminal below and prepares to make a quick parachute descent. This method may soon be used by international police in capturing liquor and drug smugglers at our borders

THE most effective policeman of the future will be, not the beat-walking patrolman, but an aviator, equipped for long flight, if necessary, to "run to earth" thieves who may attempt to escape with their loot in airplanes!

Probably not more than five, and certainly not more than 10, years from now, the aerial policeman will be so familiar to you that you will think nothing unusual of his flight across the sky. Strange as it may seem, the mind of the criminal works faster than does the mind of the law in using new developments of science.

In New York, as in some other cities, we experienced a somewhat severe awakening to this characteristic of the criminal mind. While our patrolmen were walking their beats as usual, suddenly a crime wave swept over the city. In broad daylight, desperate bandits robbed stores and looted warehouses in the busiest section of the city, rushing away to safety in high powered cars. For a time we were helpless, but finally were able to supply our patrolmen with automobiles in which they now patrol their beats. It was not long before the crime wave abated.

The next refuge for crime, I predict, will be in the air. Thieves, burglars, and gunmen will attempt to use airplanes to make their getaway. And, when they do, I hope that the larger cities of this country will be ready for them.

Literally "dropping from the sky," the sky patrolman has his gun ready in case he meets resistance when he lands

Police Now Helpless

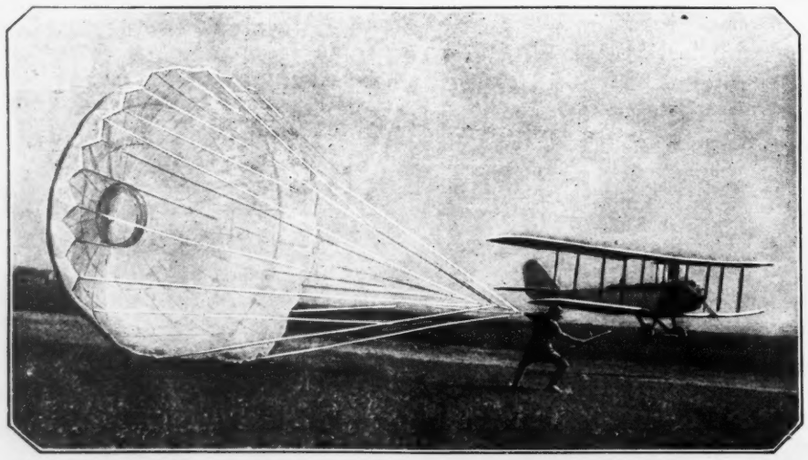
At present, the police of our large cities would be practically helpless in combatting an "aerial crime wave." Take New York City, for instance. Suppose a robbery should occur and the crook should soar away from the scene of his crime in an airplane. Although we might be able to follow him, we could not make an arrest, for it would be only a matter of a few minutes until he was in another state. So we must not only establish an aero police force with regular "sky beats" for patrolmen, but also we must change our laws so that it will be possible for an aerial policeman to make an arrest in another state and hold his man until the proper regulations for extradition have been complied with.

One of the chief functions of the aerial police force will be the detection of smuggling of liquor and drugs across the Canadian and Mexican boundary lines. On these boundaries, at regular intervals, can be established aerial police, who will hover high in the clouds, peer down through powerful telescopes, and spy on lawbreakers in time to apprehend them before they can get away. The smuggling of liquor and drugs into this country by airplane has grown to be a business of alarming proportions, and I look to see the establishment of an international aero police in the immediate future.

The eventual equipment of our aerial police may resemble that recently demonstrated at Venice, Calif. There the police observer, from his point of vantage high in the air, not only saw all that went on below him, but he was also equipped with a parachute with which he could descend quickly.

Fantastic ideas that the aerial police will be equipped with machine guns should be discouraged. The function of aerial police will be not to shoot down criminals, thus endangering the lives of innocent persons below him, but it will be literally to run down criminals, forcing them to earth at the first possible landing. There, the officer may have to resort to the use of a weapon in order to prevent desperate fugitives from making a getaway.

The policing of the air is destined to come sooner than most of us suspect. It will require a complete revision of some of our laws, and for that reason, if for no other, certainly it is high time for us to study the subject.



Throwing off the parachute harness as he lands, the sky officer gives pursuit. Meanwhile the police plane swoops down to aid in the chase

Thickening Muscles Cause "Old Age Pains"

MEDICAL science has made important progress recently in determining the causes of pains most of us experience as we grow older—pangs of limb and muscle usually characterized as "rheumatism" or "neuralgia."

"Many of these pains," says Dr. J. Madison Taylor, professor of applied therapeutics at Temple University, Philadelphia, "are not rheumatism or neuralgia at all, but a condition in which the fibers of the muscles become thickened with connective tissue, making them less pliant than usual and pressing them, when moved, on nerves that pass through them.

"Neuralgia is present," he adds, "only where painful points may be found along the course of a nerve, especially where it emerges from bone. In the muscles, the pain is in the body of the muscle, especially at the thinnest and most expanded part. Wherever muscles interlap—at the head, neck, shoulder, hip, knee, and ankle—there the muscles show the greatest tendency to thicken.

"The best method of diagnosing muscle thickening is by pressure of expert finger tips, which can detect whether there are painful points along the nerve course. The relief and cure lie not only in massage, heat, pressure, and counter-irritation by blistering, but by digestive regulation as well."

BENNY LEONARD *Tells of Science of Self Defense*

1. I raise my right forearm, warding off the thug's knife arm and pressing against his descending wrist

2. Next, I lock his upraised arm by passing my left arm around it and grasping my own right forearm

3. Finally, I break his locked arm by pressing on it, using the full weight of my body to apply the pressure

By Benny Leonard
World's Lightweight Boxing Champion

NOBODY is immune from the attack of the hold-up man. In New York State alone there were more than 2000 convictions for assault last year.

It is because that danger is ever present that I have devised a simple yet effective method of self defense which should stop the most powerful assailant.

An analysis of the majority of hold-ups reveals that the usual weapons of professional thugs are the pistol, the blackjack, and the knife.

The two general methods of repelling assaults with these weapons depend for their success on how quickly the victim can judge at which part of his body the thug is aiming his weapon. The blackjack usually is directed at the head, the knife at the throat, and the pistol at the abdomen.

The best defense against the blackjack or the knife is this:

First, raise your right forearm to ward off the descending weapon arm and press against the attacker's wrist. Quickly pass your left forearm around his upraised arm and grasp your defending right forearm with the fingers of your left hand, thus locking his weapon arm in your two arms. Now, by pulling his arm toward you and bearing down upon it with your weight, you will find that you hold your assailant powerless. Sufficient pressure applied will break his arm.

The success of this counter attack depends on how quickly you can gain the hold. The strength of your assailant counts for little.

Should the attack be directed at the lower part of your body, grasp the wrist holding the weapon with your left hand, stepping toward the attacker with your right foot. Then draw the weapon arm forward, advance your left foot and force the attacking arm under your right armpit, and across your chest, locking it by pressure applied by your upper right arm. By pressing sharply upon the thug's arm with both hands, you can readily break it across your body.

The pistol is usually directed at lower portions of the body. This requires rapid foot work in order to step out of the line of fire while grasping the wrist with the left hand preparatory to breaking the arm.

Fire Department Wrecker Rescues Horse from Sewer

Placed in a sling, the horse was hauled out by block and tackle

AFTER spending 20 hours in a sewer into which he had fallen, "Mike," a veteran city service horse of Newark, N. J., was rescued recently through the resourcefulness of firemen and street department employees.

To save the horse, the rescuers had to tear up a large section of pavement, dig down four feet and break a hole 10 feet long by four feet wide in the heavy brick roof of the sewer.

When he fell into the manhole, "Mike" wandered through the sewer for about 10 blocks. For eight hours firemen and police searched for him. When finally he was located, and the hole was dug in the sewer, he was placed in a sling by firemen, then hoisted to the street by a block and tackle attached to a fire department wrecker. He was uninjured, but it cost the city about $500 to rescue the $250 animal.

Lining a Water-Filled Sluice

How water in the power ditch is used for transporting the concrete with which the ditch is being lined. The concrete is carried in the huge steel tubs shown above.

On the left bank of the ditch is one of the forms used for molding the semicircular lining slabs. Liquid concrete is shot into the forms to a thickness of two inches

HIGH up in the Sierra Mountains near Placerville, Calif., where roads are scarce, engineers working on the El Dorado water power project have solved the problem of transporting materials by the adoption of big steel tubs as carriers. The tubs are used as barges to carry concrete with which an old 25-mile canal is being lined to serve as a power ditch. On account of the lack of roads, the water itself is made to carry the materials.

At the upstream end of the ditch a large crusher is located. Sand from this plant is put into the tubs and they are sent whirling downstream to the point where the material is needed.

When the tubs are emptied, they are floated down to a derrick fixed at a point where the ditch is crossed by the main highway. Here they are hoisted out of the ditch and taken back to the crusher by motor truck.

Two hundred of these tubs are being used on the job. Each has a carrying capacity of 3000 pounds, and when fully loaded, floats about eight inches out of water.

The feat of lining the ditch with concrete while water is flowing in it presents another interesting engineering problem.

Pre-cast semicircular slabs of gunite are used as lining. These slabs are built on a semicircular steel form fitted along the edges with a slotted shoulder. By means of thumbscrews at the slots, each strand of the reinforcing mesh in the slab to be made is firmly held in place against the form. The forms are stationed along the banks of the ditch and gunite is shot onto them to a thickness of two inches.

The form and its concrete slab are then lowered by derrick into the water-filled ditch. When the slab is in place, the wires are released at the thumbscrews and the form is lifted clear, leaving the slab in place.

Forms Float to Next Job

The forms are then floated downstream on a barge to another derrick, where they are picked up. Then they are used again in the same way.

The sections of lining are separated by spacer blocks at a fixed distance from the previous section, and after several hundred feet of section linings is put down, the water is shut off temporarily and gunite is shot into the spaces between the sections, making a complete concrete lining in the ditch.

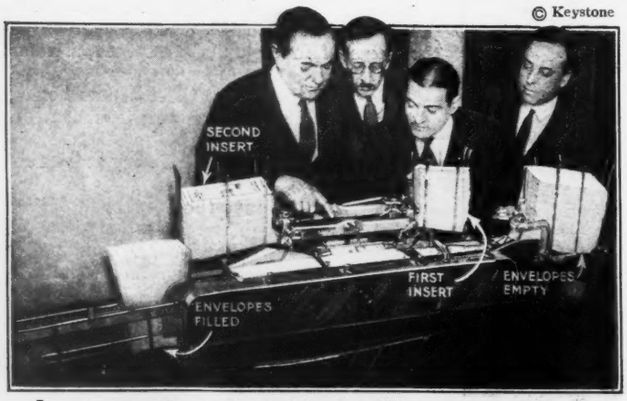
Machine Fills and Seals Envelopes

A MAILING machine that handles two inserts or inclosures, inserts them in an envelope, and seals the envelope ready for the mail at a rate of 4500 letters an hour, is the result of 11 years' work by Charles L. Lovercheck, of St. Louis.

The envelope is picked up by a clamplike device placed at regular intervals on an endless chain. Operating at the same rate of speed is a twofold device that draws the two inclosures together at the center of the machine. Mechanical fingers, moving back and forth, then insert the folders in the envelope and it passes on to be sealed and counted by a register, which is tripped by the filled envelope. Power is obtained from a small motor.

It is estimated that the machine does the work of 10 expert fillers and makes possible quantity letter production. The picture at left gives a clear idea of the machine's progressive action from the start to the finish.

© Keystone



In one operation this machine handles two inserts from separate piles, puts them into an envelope, and seals it

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THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Mermaid Swims in Safety Harness

Water Suspenders, Fishing Balloons, Are Novel Summer Sport Inventions

ALL set for a high dive! Timid? Not a bit. This Atlantic City bathing beauty has donned safety swimming suspenders, the very latest in water sport accessories. The fun beginners and experts have enjoyed with auto tire tubes in the water has led to the invention of an inflated rubber tube harness that can be fitted easily over the shoulders of the bather and strapped about the waist, as shown at the right. The suspenders are said to be especially useful to swimming pupils. They serve also in giving security against the ever-present peril of cramps

IN ATTEMPTS to leap from a speeding train to a ladder hung from an airplane traveling at 100 miles an hour, Barney Rowe nearly came to grief. On his last attempt the ladder caught in a telephone pole, nearly wrecking the plane. Rowe is shown running along the top of the train

FISHING for bass with balloons has become a popular sport recently in California, because it combines the comforts of shore fishing with the advantages of fishing from a boat, and also provides rifle practice. Three balloons filled with hydrogen carry the line far out over the lake or river, trailing live bait on the surface of the water. Pot shots with a rifle put the balloons out of commission when the bass is hooked

The World's Largest Photo

How Famous Sculptor Will Use Granite Cliff as Sensitized Paper in Carving Confederate Memorial

THE world's largest photograph, projected by the world's largest projection lamp and printed on the granite side of Stone Mountain, Georgia, the world's largest monolith.

That is the stupendous project to be undertaken early this summer by Gutzon Borglum, the famous sculptor.

The feat will be attempted as the first step in carving an immense memorial to the Confederate soldiers on the side of the mountain, a sheer granite cliff about 900 feet high and 1200 feet wide. By means of the photograph, the artist will obtain the correct proportions for his colossal figures.

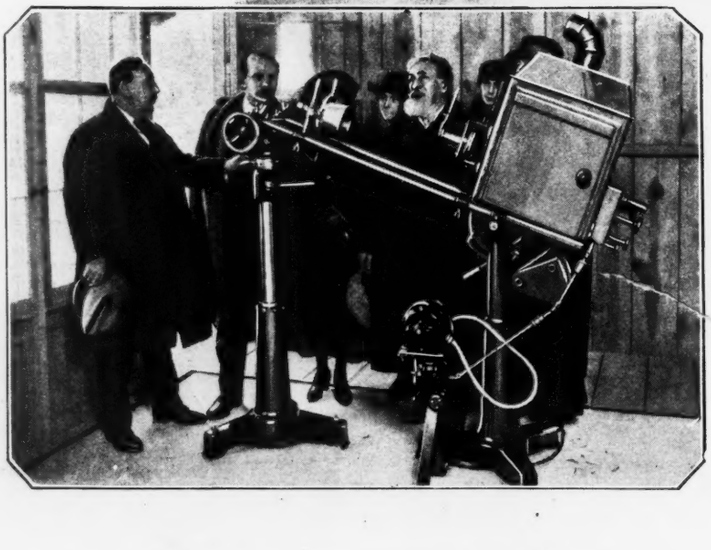
When finished, the memorial will show the Confederate army—infantry, artillery and cavalry—passing in review before General Robert E. Lee, Jefferson Davis, and other leaders of the Confederacy. It will occupy a space 110 feet high by 700 feet wide.

In making his gigantic photograph, Borglum will use the same chemicals and methods employed by the ordinary photographer.

The black night will be the sculptor's darkroom; the granite face of the cliff his sensitized "paper." Where the ordinary photographer uses small quantities of developing chemicals, the sculptor will use barrels of it.

Borglum has already set up his projection machine at the base of the mountain, 700 feet from the spot on the cliff where the figures will be carved. This lamp uses a slide five eighths of an inch in size, but throws the figures in large detail on the cliff.

Because of the upward projection at an angle of about 45 degrees, the huge figures will actually be distorted on the cliff. Yet this very distortion will make them appear in correct proportions to spectators below.



How Gutzon Borglum, famous sculptor, will print a colossal photograph on the sensitized granite face of Stone Mountain. This photograph will serve as a pattern for carving a heroic Confederate memorial. At the left is the projection machine

With his projection machine ready to throw the images on the face of the cliff, Borglum proposes to lower men down the mountainside at night with several barrels of nitrate of silver. This will be poured

On a Mountainside

At right: Sketching the nine-foot head of Gen. Robert E. Lee on the face of Stone Mountain

over part of the cliff to sensitize the granite. The picture then will be projected on the sensitized surface and a time exposure of several hours will be taken. Several barrels of developer then will be poured over the rock to "set" the picture. Water will be poured over the whole from the top of the cliff to wash the picture.

Sculptors will descend the face of the rock by cable and carve out the figures thus photographed.

No attempt will be made to photograph the entire work at once. The plan is to make a series of photographs, each 110 feet high by 220 feet wide, projecting only part of the photograph at a time.

Some idea of the magnitude of the carvings can be gained from the outline of General Lee's head, shown on this page, which has already been sketched on the mountain. The head is nine feet high. The completed figure of the general on his charger will be 82 feet high. All the other figures will be carved in equally heroic proportions. There will be about 1000 figures in all, including famous generals.

The huge figures will be visible for miles, and will rival in colossal sculpture the Sphinx of Egypt.

The most difficult problem in the huge task of carving the side of the mountain was getting the figures outlined. The sculptor could not do it himself by being lowered over the side of the mountain, because he would be so close to the face of the rock that he would lack perspective. The plan to photograph the figures on the mountain itself was evolved to solve this difficulty.

Steel Mattresses to Preserve Automobile Highways

STEEL frames resembling mattresses and used as reinforcements for concrete roadways, are now being employed to prevent the cracking of the pavement due to settling of the roadbed and expansion resulting from changes in temperature.

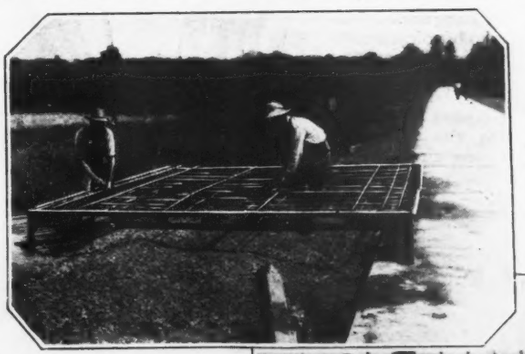
How Concrete Form Is Used

In building a road by the new method, the old roadbed is first excavated to a depth of eight inches, then rolled smooth. The reinforcing form, consisting of steel bars bound together with wire, is assembled on the job and forms a framework 10 feet long, eight feet wide, and six inches deep. The form then is placed upon the previously construeted roadbed. The concrete mixture is poured in on the frame and the surfacing completed as in the case of an unreinforced road.

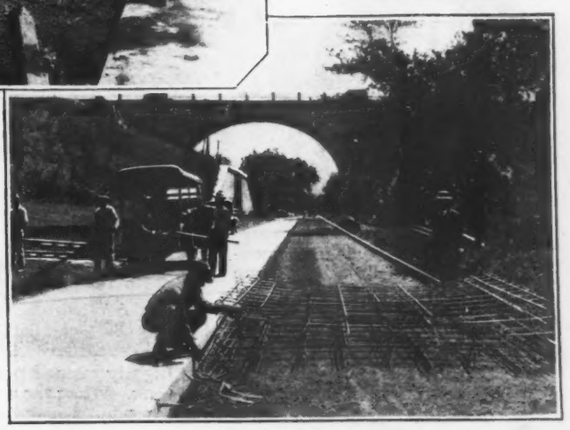
Thus the steel takes up the strains that formerly were taken up by the concrete and that at times have caused very severe fractures, increasing the cost of maintenance.

The completed highway consists of a series of reinforced concrete slabs. A slight settling of the roadbed will not cause the slabs to sink into the depression thus formed, it is claimed, since the steel framework acts as a supporting beam across the roadway. This method of construction is said also to make the highway immune from damage by frost — an advantage in extreme climates.

It is claimed that the steel reinforcement will double the life of a concrete road.



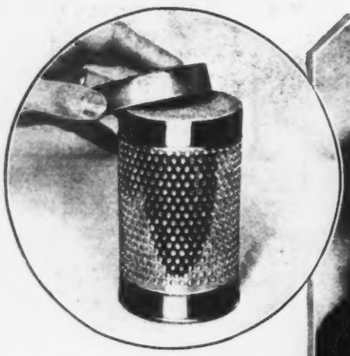
At left: Assembling the reinforcing steel mattress at the side of the road. The frame is formed by binding steel bars together with wire



Below: How the mattress is laid on the roadbed. The concrete mixture is poured into the frame, which helps carry the load of traffic

Our Radio Editor Announces

Scientific Aids for the Housewife

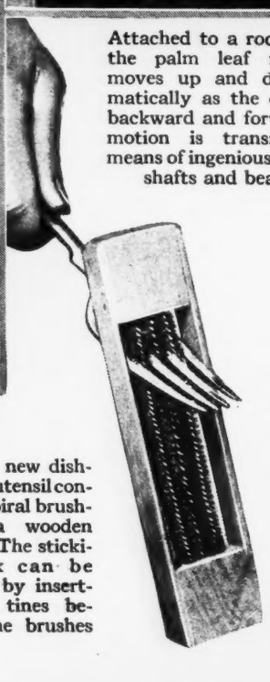


Just as an ordinary sponge absorbs water, this chemical sponge absorbs disagreeable odors. It is for use in refrigerators, to prevent contamination of food by odors

Attached to a rocking chair, the palm leaf fan shown moves up and down automatically as the chair rocks backward and forward. The motion is transmitted by means of ingeniously arranged shafts and bearings

These two rings are the newest inventions for canning. The lower ring, of rubber, holds the preserving jar, while the upper metal ring with strong handle removes or tightens the cover

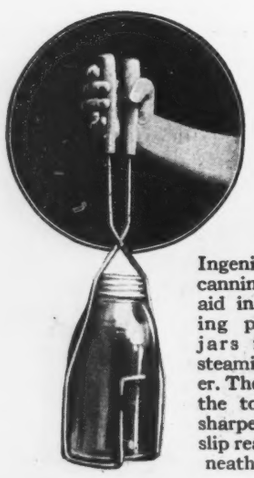
Based on the theory that rubber will erase dirt from clothes just as it will erase pencil marks from paper, this washboard has a fluted rubber surface which, it is claimed, will extract dirt like magic from the finest linen, silks, and laces



A handy new dish-washing utensil consists of spiral brushes in a wooden frame. The stickiest fork can be cleansed by inserting the tines between the brushes

When the sink becomes stopped up, this easily operated hand pump forces the sediment down through the pipe. No need for the housewife to call a plumber

This new electric washing machine needs no wringer. Once the clothes are washed, the operator raises the clothes container to the top, where it whirls around until the clothes are as dry as if they had passed through a wringer



Ingenious wire canning tongs aid in removing preserve jars from a steaming boiler. The jaws of the tongs are sharpened to slip readily beneath the jar

Lightly capped preserve jars are placed in a water filled tank. When the water is pumped out, the partial vacuum produced sucks air from the jars and tightens the lids

Besides supplying illumination, the electric lamp shown above contains an electric heater and a fan that serves as a dryer. All are mounted under a decorative shade

Our Radio Editor Announces

America's First Radio Telephone Exchange

Reflected Waves Promise Better Broadcasting

By Jack Binns

Jack Binns, world's most popular writer on radio, contributing exclusively to Popular Science Monthly

RADIO fans of Cleveland, Ohio, who own crystal detector sets, got the surprise of their lives recently. Clearly and distinctly they heard broadcasting station KDKA in Pittsburgh, Pa., more than 125 miles away!

For days the apparent miracle of receiving long distance broadcasts with sets supposed to have a range of only about 25 miles, thrilled and mystified the Cleveland fans. And then the secret leaked out. It was this:

They were hearing the Pittsburgh signals, surely enough; but they were hearing these signals reradiated to them by a new radio station located in Cleveland—the first real radiotelephone exchange!

A Way to Saner Broadcasting

This incident reopens the possibility that radiotelephony eventually may supersede our wired telephone system, and that private radiotelephone conversation may be attained at last. And, more than that, it suddenly unfolds a pathway toward sane radio broadcasting development on a national basis—the broadcasting of a single program throughout the country from one centrally located station.

How? Simply through the discovery of a successful means of reradiating or relaying radio messages from one broadcasting station to another, just as a branch telephone exchange relays long distance messages from a central toll station.

The new radio achievement developed from a series of minor experiments that began six months ago, when engineers of a large manufacturing company that operates a series of important broadcasting stations, started out to find the effect of simultaneous radiation of a program from Pittsburgh on two different wave lengths. At about the same time this company decided to construct another broadcasting station in Cleveland, where conditions for distant reception had been peculiarly unfavorable, though it was within normal range of the Pittsburgh station.

Work on this station was going along steadily, when the engineer in charge had an idea:

"Why not reradiate and relay our 100-meter Pittsburgh wave from this new station?"

The idea was adopted. The necessary receiving equipment was installed at Cleveland, and was connected with the modulating system of the new Cleveland transmitter.

The result was the surprise for Cleveland fans already mentioned.

Just what is the immediate significance of this achievement? We can find the answer, perhaps, by considering all previous efforts at long distance radio control. The best illustration is the method by which the Princeton-Chicago football game at Chicago last fall was broadcasted in New York.

Before the voices of the crowd and the announcer at the game could be radiated at New York, they had to be carried one third the way across the continent by specially prepared long distance telephone toll lines. These vocal sounds had to be amplified first at the playing field, then at about six repeater stations in various cities between Chicago and New York. And, finally, to insure perfect results, no less than three pairs of cross country wires had to be reserved—one for actual use, a second as a standby in case of emergency, and the third for the exclusive use of control operators.

Now, at a single stroke we have a new agency for linking our radio broadcasting stations and it is here that the value of a second development comes in. I refer to the recent remarkable experiments by Marconi with reflected wave telephony.

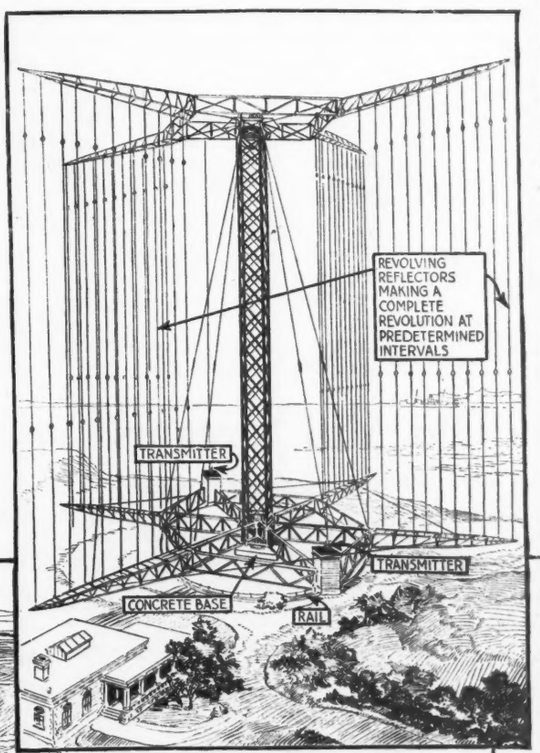
Directing a Radio Beam

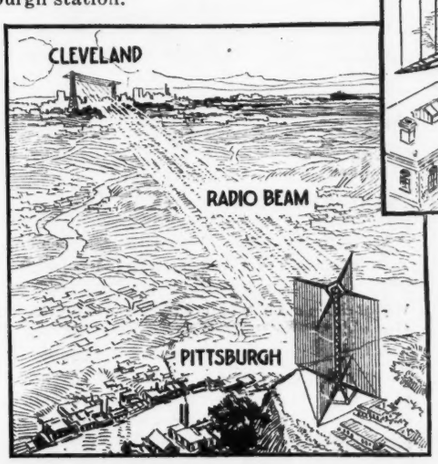
Instead of radiating the controlling wave in every direction, why not use the greater directional efficiency of reflected waves, as developed by Marconi?

Suppose, for example, the central station directs its reflected wave to another station on a 50-meter wave length. The second station reradiates it for the benefit of radio fans in its territory on a 360- or 400-meter wave. There is no reason why this second station should not also automatically control another distant station operating with a reflected wave of still a different length, relaying the program originally sent out by the first station. In addition, each of the controlled relay stations might simultaneously broadcast other programs at other wave lengths. In this manner broadcasting could be operated most economically. National announcements could be radiated thus from Washington.

Marconi's system of radio reflection may be compared to a lighthouse. We know that if we place reflectors behind a lamp so that its beams are concentrated in one direction, the light will reach a great distance.

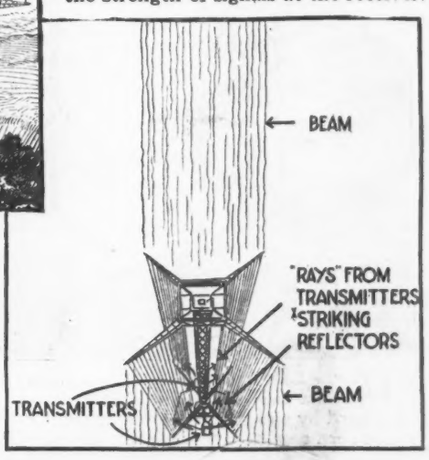
The same basic principle controls the radiation of the electromagnetic waves of radio. Experiments in 90-mile radio communication between London and Birmingham, England, have shown that reflected radio radiation triples the strength of signals at the receiver.





THE drawing above shows the construction of an experimental wireless reflector erected in Scotland. By revolving reflector aerials, waves sent out by transmitters are reflected and radiated in any predetermined direction, as shown at the right.

A reflector of this type at Pittsburgh has made possible the new radio exchange at Cleveland, Ohio, where messages radiated from Pittsburgh have been received and reradiated with surprising success.

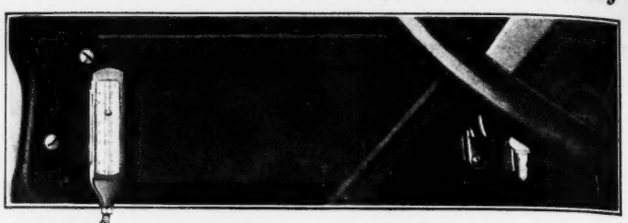


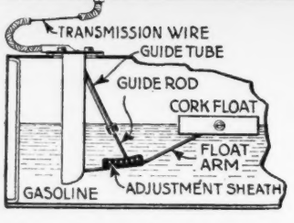
Traffic Light in Glove

The white gloved hand of the traffic officer is lighted by the electrical apparatus shown at right

FOUR electric bulbs concealed in a wristlet are a new invention to illuminate the white gloved hand of the traffic policemen and thus provide effective night traffic signals.

The current for these lights is obtained from small storage batteries hung from the policeman's belt. This current is led to two contacts on the hand.





How the gasoline indicator is controlled by a cork float in the tank

Cork Float Controls Gasoline Indicator on Dashboard

AUTOMOBILISTS now may know the amount of gasoline in their cars without the necessity of getting out to inspect the gage in the rear of it through the recent invention, by a manufacturer of Dayton, Ohio, of a visible gage attached to the dash near the steering wheel.

The gage can be attached to any make of car. It is actuated by a cork float in the gasoline reservoir. The rising of the float causes a piston to push forward a flexible wire contained within a hollow tubing leading to the indicator unit. To this wire is attached a red ball that indicates how high the float has risen and hence the amount of gasoline. Adjusting holes in the float arm permit the regulating of the piston movement so as to make the indicator readings conform to the size of the tank.

The inventor believes that the new device will help motorists keep accurate tabs on their gasoline supply.

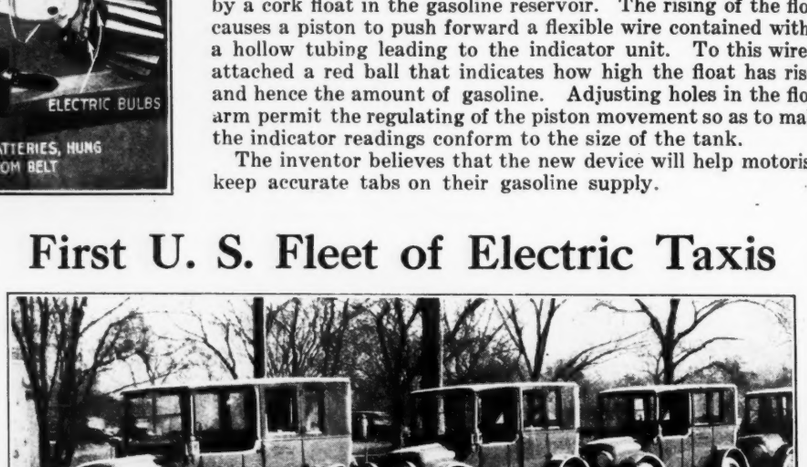
Novel Elliptic Truck Spring Needs No Lubrication

A THREE-QUARTER elliptic truck spring that requires no lubrication and is said to possess wonderful shock absorbing qualities consists of two members the lower of which has a full set of leaves and the upper only half a set, all bolted to the frame.

Any distortion due to loading is absorbed by the unique arrangement of the leaves.

How two sets of spring leaves are bolted to the truck frame

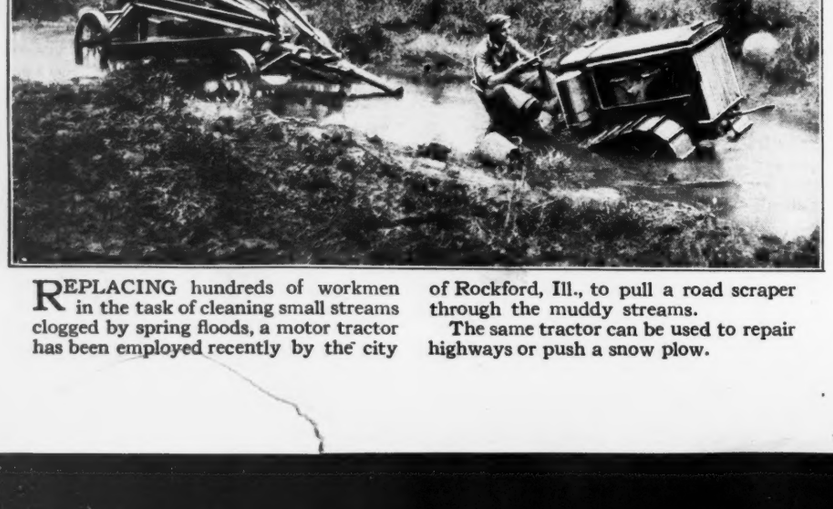
First U. S. Fleet of Electric Taxis



THE first American fleet of electric taxicabs has just been placed in service in New York City to serve particularly the theater district.

The operating company plans to work the machines in two shifts, keeping them on the job from 18 to 20 hours a day. Since two sets of batteries are used, the battery compartments are specially designed for rapid changing. The cars will have a daily operating radius of about 120 miles and a maximum speed of 25 miles an hour.

Tractor Dredges Old Mill Streams



REPLACING hundreds of workmen in the task of cleaning small streams clogged by spring floods, a motor tractor has been employed recently by the city of Rockford, Ill., to pull a road scraper through the muddy streams.

The same tractor can be used to repair highways or push a snow plow.

New Dustless Water Goggles

A NOVEL type of dustless goggles contains a circular chamber behind the glass. This chamber is partly filled with water so as to wash the inner surface of the glass.

When the glass becomes fogged, the wearer nods his head, splashing the water over the glass. Resuming the erect position, the water returns to the bottom of the chamber and the fog or dust is gone.

Why an Auto Engine Misses

And How to Put Your Finger on Ignition Trouble when Your Motor Stalls—Explained by an Expert

By Harold F. Blanchard

IGNITION trouble is a bugbear that hangs over most motorists, always threatening them with the possibility of a stalled engine on a lonely road. Yet ignition trouble is really not hard to locate and remedy; and it is still easier to avoid ignition defects.

The whole secret lies in gaining a clear idea of just what an automobile ignition system is and how it works.

The heart of the system, of course, is the battery that supplies the electric current. This current passes through two electric circuits—a low tension circuit and a high tension circuit, connected by a magnetic coil. Intercepting the low tension circuit is the ignition switch, a sort of electrical drawbridge. When it is open, nothing happens. When it is closed, current from the battery is allowed to pass through the circuit.

In the low tension circuit also are the breaker points—two points of metal that are alternately brought together and separated at intervals by a cam controlled by the revolutions of the engine. The breaker points govern intervals between sparks in the engine cylinders.

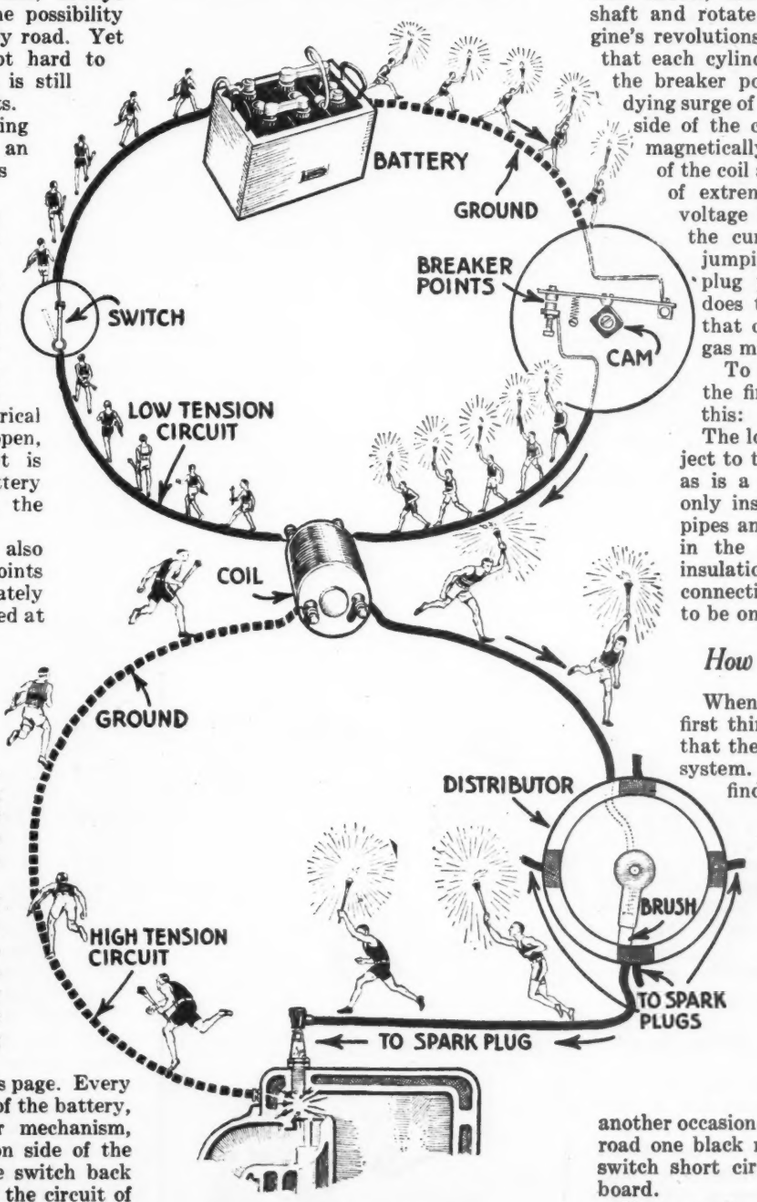
Inserted in the high tension circuit are the spark plugs and the distributor that switches the current to them in turn by means of a brush.

Now, to get a clear idea of how the whole system works, consider the wiring of the two circuits as two circular race-tracks, around which relay racers carrying electric torches travel at lightning speed.

Look at the diagram on this page. Every so often a runner climbs out of the battery, dashes through the breaker mechanism, then through the low tension side of the coil, and finally through the switch back into the battery, completing the circuit of the low tension wiring. Such a round trip is made every time the engine, acting through a rotating cam, separates the breaker points.

From Coil to the Spark Plugs

The trip of each runner is uneventful until he dashes through the coil. Here he jumps on the short end of a seesaw. As he does so, another runner seated on the other end of the seesaw starts around a second, high tension, circuit at 100 times the first runner's speed. When the high tension runner reaches the middle of the distributor, the brush, which really is a rotating switch, sweeps him to one of the spark plugs. Reaching his final goal—the cylinder—he sets the charge on fire and then proceeds back to the coil by way of the engine and the frame, as indicated by the dotted line in the illustration.



A Typical Ignition System

HERE is a novel wiring diagram of a typical automobile ignition system, showing low tension and high tension circuits in the form of two circular race tracks. The flow of electric current from the battery is represented by the runners.

Cut out this diagram and tack it on the wall of your garage for future reference. It will save you time and trouble when your engine misses or stalls

That's the whole ignition system in a nutshell. The remarkable thing about it is the clockwork precision, the teamwork of the runners in the two circuits. This is due to the fact that the cam actuating the breaker points in the low tension circuit and the distributor brush in the high tension circuit, are mounted on the same shaft and rotate in unison with the engine's revolutions. At the exact moment that each cylinder is ready for a spark, the breaker points separate, causing a dying surge of current in the low tension side of the coil. This current reacts magnetically on the high tension side of the coil and creates in it a current of extremely high voltage. The voltage is so high, in fact, that the current has no trouble in jumping the gap at the spark plug points, and whenever it does this, it produces a spark that causes the ignition of the gas mixture in the cylinders.

To avoid ignition troubles, the first point to remember is this:

The low tension current is subject to the same kind of ailments as is a system of house piping, only instead of leaky or clogged pipes and broken valves we have in the wiring system defective insulation, short circuits, loose connections, and dirt for which to be on the lookout.

How to Find the Trouble

When your engine stalls, the first thing to do is to make sure that the trouble is in the ignition system. Tickle the carbureter to find out whether the gasoline is low. Always be prepared for the unexpected.

Often the simplest things prove most unexpected. I remember once when foot operated (kick) switches were popular. I was driving along one night when suddenly my engine stopped. After a long search for the trouble, I found that my companion had accidentally kicked the switch off. On another occasion my engine died on a lonely road one black night because the ignition switch short circuited on the instrument board.

If an engine is equipped with a high tension magneto, the first thing to do when it balks is disconnect the short circuiting wire leading from switch to magneto. When this is done, the engine must be shut off.

In another case, where dry cells in the toolbox were used in connection with a magneto, it was found that a stalled engine was caused by one of the cells coming into contact with the metal side of the box.

A half-hour drive through a heavy rain will cause the engine to stall, due to the fact that the moisture permeates the high tension insulation. The wiring must be thoroughly dried before the engine will run again.

Another important point to remember when the engine stalls: Be sure the switch is on *all* the way. Some switches appear to be on when they are just a little bit *off*. Then go over the wiring carefully; first the

low tension wiring, then the high tension wiring. Look for loose or dirty connections, worn insulation, or strands of wire out of place. Dirty connections should be scraped with a knife or sandpapered. Loose connections should be screwed tightly.

Wherever a wire has been wrapped around a binding post, be sure that a single strand has not gone astray and caused a short circuit. Insulation frequently chafes through, and the bare wire causes a short circuit. Feel all wires carefully for bare spots and tape any suspected places. Occasionally a wire will break within the insulation. The best thing is to replace it.

Switch May Cause Stalled Engine

One glance at the wiring diagram on page 71 will tell you that any trouble in the switch may cause a stalled engine. Where you are suspicious of the switch, it is a good plan temporarily to run a wire direct from the storage battery, connecting with the breaker mechanism and the low tension side of the coil.

Dirty connections are most likely to occur at the battery, due to corrosion by sulphuric acid fumes escaping from the electrolyte. The remedy is to clean the battery connections carefully, wash them in ammonia, and coat them with vaseline.

Loose connections are likely to cause trouble in the low tension circuit. Incidentally, much ignition trouble may be avoided by periodically tightening all ignition nuts. If you discover no loose connections, the next step is to remove the distributor cap and examine the distributor and breaker mechanism. Usually the breaker is right under the distributor brush. The distributor should be clean and dry, and if it is not, should be wiped with a cloth moistened in gasoline.

Have some one turn the engine over slowly while you watch the breaker mechanism function. On most cars the breaker points should separate about one sixty-fourth of an inch or a little less. See that the points actually separate and that they actually come together again. If the car is equipped with an ammeter, it should read "discharge" when the points are together and "charge" when they are separated; although if the engine is stalled, it is possible that the reading will not change.

When Breaker Points Burn Away

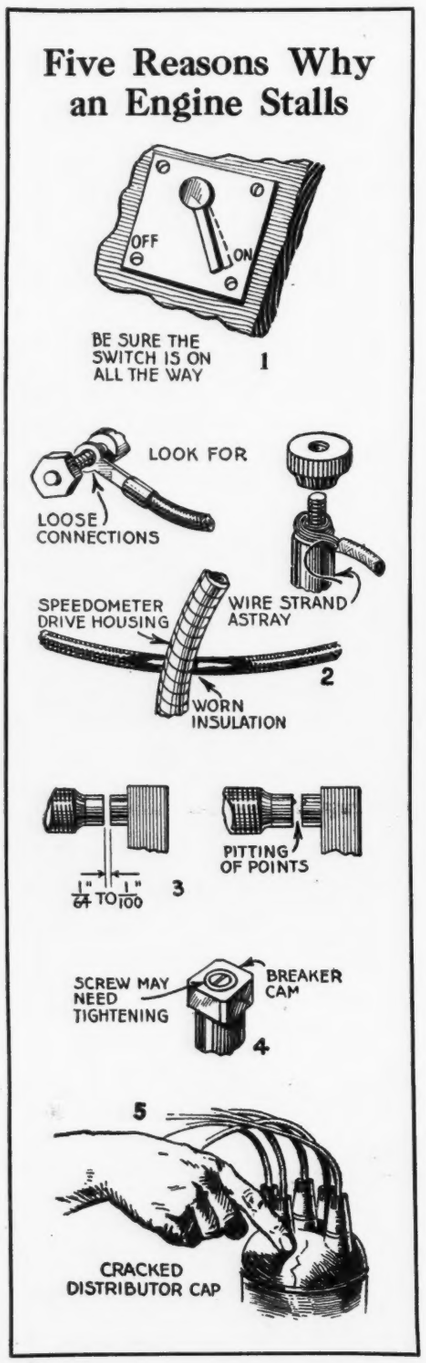
Breaker points gradually burn away as they are used. Their surfaces become jagged instead of smooth. These irregularities disturb the adjustment and sometimes they wipe out the gap between the points completely. Or a little piece of metal may break off and lodge between the points, short circuiting them and stalling the engine.

To smooth the surfaces of the points, dress them with a fine file or grind them on a fine emery wheel, then adjust them carefully. If the points are too far apart, the engine may miss at low speeds or may refuse to run at all. If they are too close together, the engine may miss at high speeds. Be sure the surfaces are free from grease.

If the breaker points burn away rapidly, the condenser may be defective or loose. A broken condenser is usually indicated by a "discharge" reading on the ammeter when all lighting switches are open and the breaker points are separated.

If the spring that holds the breaker to the cam breaks, or if the shaft on which the cam is mounted is loose in its bearings, the engine may balk. A loose distributor shaft is still more likely to cause missing.

Sometimes the breaker cam becomes loose, due to the loosening of the screw that holds it to the shaft, causing a stalled engine. The same defect sometimes will cause the engine to give forth an occasional explosion as it is cranked. When the ignition unit is driven from the pump shaft, a breakage in the pump coupling may stall the engine.



Occasionally stalling is caused by the breaking down of a coil. In that case a low tension circuit may be in perfect order, yet no sparks will be generated in the high tension circuit. Even the main high tension wire running from the coil to the distributor may not supply a spark.

If the engine stalls because of some fault in the high tension system, the trouble can be located easily. Be sure that the wire running from the coil to the distributor brush is properly connected and its insulation is in good condition. See that the distributor cap is dry and clean inside and out, the brush in place and functioning properly, and the cap properly attached. Finally, see that wires and spark plugs are dry.

Causes of Engine Misses

A missing engine, in fact, almost all other ignition troubles, resemble those described for a stalled engine, only the trouble is less acute. The most common cause of missing is a defective spark plug. The defect may be a cracked porcelain or the sparking points may be too far apart or too close together, or the plug may be coated with carbon or oil soaked. Adjust the points, clean the porcelain of oil and carbon. If the porcelain is cracked, better buy a new plug. Sometimes an invisible hair crack will cause the trouble.

The quickest way to determine which cylinder is missing is to open the petcocks or priming cups one by one while the engine is running. If the explosions in one cylinder feel weak or irregular when you place your thumb close to the cup opening, or if no flame is observed through the opening, that cylinder probably is the one that is missing.

Other causes of ignition missing are defective high tension wires; high tension wires connected with the wrong plugs or with the wrong terminals on the distributor housing; partially wet wires; wet distributor; loose distributor shaft; breaker points out of adjustment; condenser in need of repair, and, finally, a recurring short circuit in the low tension wiring or in the main wire running from the coil to the distributor brush.

Suppose the insulation chafes off on one of the low tension wires and that occasionally the bare wire swings against the rear corner of the cylinder block. Whenever it makes good contact, it causes a miss in your engine.

When the Engine Lacks Power

Lack of engine power may be due to weak magnets in the magneto or to a very weak battery. Spark plug points or breaker points out of adjustment are other frequent causes of engine weakness. The right adjustment for spark plug points is the thickness of a thin dime.

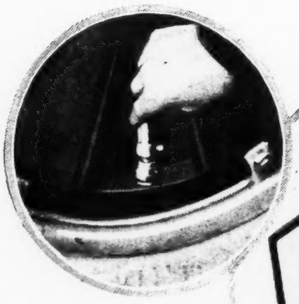
Trouble in the coil or in the condenser, or, in fact, any leak or derangement, is likely to show up as lost power, while not sufficient to cause a miss. For example, if the high tension wires are old, it is possible that most of the high tension current will leak through the wires to the atmosphere and that only enough will reach the spark plugs to run the engine feebly.

Difficulties in Starting

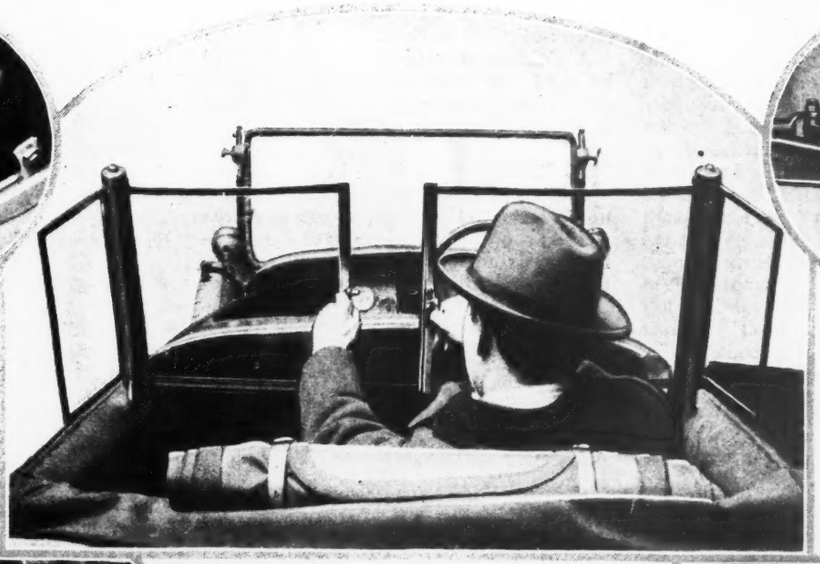
If the engine is hard to start, the very first place to look is at the breaker points. They may be too far apart or too close together. The best distance is a sixty-fourth to one one-hundreth inch apart. Wet wires, wet spark plugs, spark plug points too far apart, distributor dirty or brush badly worn are also common causes.

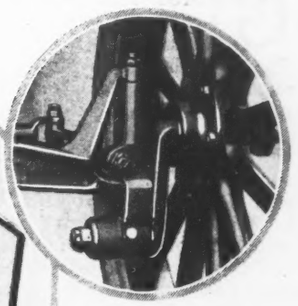
When the engine balks only occasionally, the most likely cause is a wire that makes a temporary short circuit. A particle of metal may short circuit the breaker points for a time and this must not be overlooked. There may be a defect in the breaker or distributor mechanism or if the ignition system is provided with a safety spark gap, it may be short circuited—a drop of water will do it.

New Car Comforts for the Summer



A straight upward pull quickly removes this valve cap, which is easier even than unscrewing. A spring holds the cap in place when it is pressed down over the valve nipple



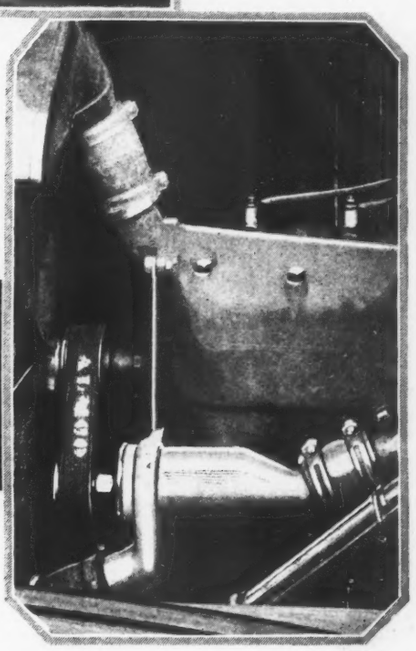


An ingenious springless shock absorber for Fords, causes the wheel to stop for an instant when striking an obstruction. The backward swing of the suspension arm takes up the shock

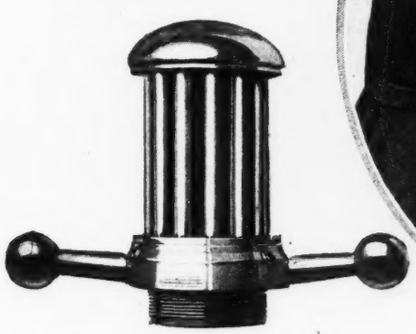
Clamped to the steering post, this steering control for Fords acts through two cams to keep the front wheels from wabbling and prevent the wheel's being jerked out of the driver's hands over rough roads. An adjustable coilspring supplies the tension between the cams

This celluloid windshield for the protection of rear seat passengers rolls up into cylinders at the side when not in use. The side panels are adjustable

A new type of rubber tire, stretched over the wooden steering wheel, provides a slipless grip for the driver's hands

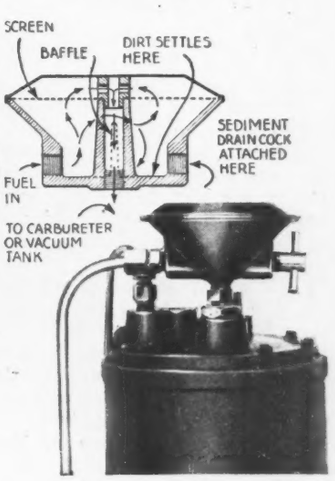


This new turbine pump for Fords assures circulation of the water and reduces the possibility of overheating



This condenser fastens to radiator cap and cools the hot engine vapors, returning the cool condensed liquid to the tank

A novel collapsible fabric bucket, with a spout and a bail, can be knocked down into a compact roll



A baffle wall in this new gasoline filter causes impurities to drop to the bottom, where they can be drained off

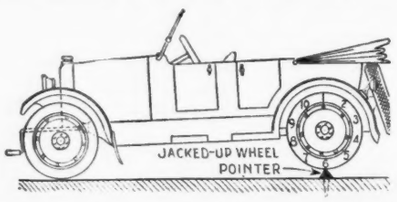
Upkeep "Kinks" for the Car Owner

GARAGE men often say that a car has more power when thrown into reverse than it has in low gear. To know whether this is true or not, one must be able to find the true ratio of his own car. This can be done quickly as follows:

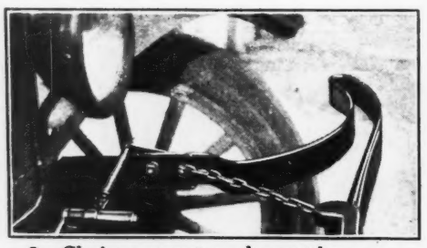
Jack up one rear wheel and divide the tire into 10 equal parts, numbered, as shown in Fig. 1. Relieve the hard compression of the engine by opening the petcocks or screwing out the spark plugs, and turn over the motor with the crank, so that the No. 10 mark on the rear wheel corresponds with a stick driven in the ground to act as a pointer. Then throw the car into low gear and turn the crank until the rear wheel has made one revolution, counting the turns of the crank and estimating the fractional part of the last turn, if any.

For one popular and much used car the low gear will be 6½ turns of the crank to one turn of the wheel. Repeat the operation for all the speeds and the reverse. The correct ratio will be found in each instance by multiplying the number of revolutions of the crank by two, since the free wheel revolves twice as fast as it would normally when two wheels are on the ground.

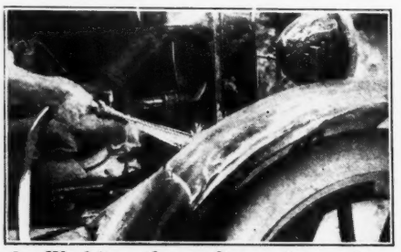
A driver who knows his gear ratio can often take advantage of the knowledge if stuck on a very hard pull by reversing his car and pulling out backward. On Western deserts many a big disabled car has been towed to a garage by a "flivver" running backward. —J. V. R.



1. Finding the gear ratio of your car



2. Chains prevent unpleasant bumper vibration



3. Washing the radiator from the inside

THE vibration of your automobile bumper can be reduced quickly and easily by the use of two short lengths of strong, light chain, as shown in Fig. 2. One end of each chain is fastened to the chassis frame or extension and the other to the bumper cross member.

To make sure that the vibration will be thoroughly eliminated, take pains to string the chains tightly. They should draw in the cross member of the bumper at least to the same extent as it bends inward when vibrating. This inward bend can be seen in the photograph.—F. W. H.

THE next time you unreel the hose to give the old bus a cleaning, don't make the mistake of throwing water through the radiator honeycomb from the front. The small openings tend to break up the stream of water into a fine spray, with consequent damage to the ignition system.

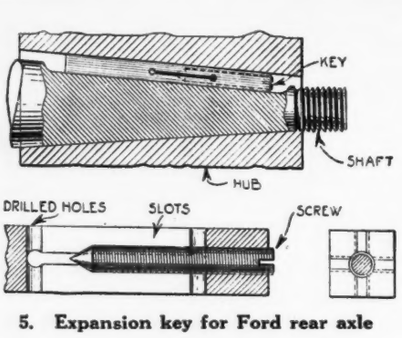
The dead grasshoppers and beetles and small chunks of mud that collect in the radiator comb should be removed the way they entered, by washing them out from behind with a stream of water (Fig. 3). Then wash the front gently by unscrewing the nozzle so as to allow only a sluggish stream of water to flow.

A violent spray of water should never be used for washing the outside of an automobile, because it is certain in time to damage the finish.—D. R. V. H.

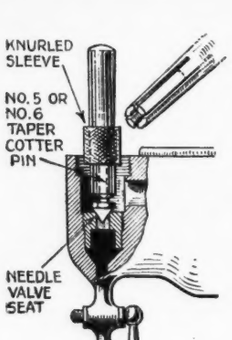
TO REPLACE a piston in the cylinder of an engine is a trying one-man job unless some special form of compressor is used to counteract the spring of the piston rings. A simple expedient for overcoming this difficulty is to place an old ring over

PLACING ONE RING OVER ANOTHER CONTRACTS THE INSIDE RING ENOUGH TO ENTER CYLINDER BORE
INSIDE RING
EXTRA RING
PISTON
EXTRA RING

4. Replacing piston



5. Expansion key for Ford rear axle



6. Grinding needle valve

7. Crowning lower fan pulley

8. Wheel guide for backing

the new ring on the piston, as at Fig. 4. The pressure will compress the new ring so that it can be worked into the cylinder.

This little kink saves both time and patience, especially when replacing pistons with some of the patented oil seal rings, which are made up of several small rings and are particularly hard to manage.

THE expanding key shown in Fig. 5 was designed to overcome the difficulty caused when keys in the Ford rear axle come loose and allow the wheel to wabble, as well as to expand and take up the slack in old worn wheels.

The upper detail shows the end of a Ford rear axle and a section of the hub, as well as the square feather key used. When this key becomes loose, it can be tightened by expanding it about the center of its length. This is done by drilling two cross holes ⅛ in. in diameter and about 2 in. apart, center to center. The metal between these holes is then slit out either by hand or with a milling cutter. A hole is then drilled in the end of the key for a cone pointed setscrew, the end of which should come about the middle of the slot.

It is obvious that after inserting the key in place, it can be expanded in the center by screwing in the setscrew. The key still remains sufficiently strong, since its shearing strength is far in excess of the driving power of the car.—W. B. B.

IN GRINDING a small needle valve such as in a carbureter, the stem may be held in a fixture quickly made from either a No. 5 or a No. 6 tapered cotterpin. The pin is drilled and split lengthwise, as shown, the prongs being sprung against the valve stem by pushing a knurled collar over them. The tool is rotated by rolling it between the palms of the hands. (Fig. 6.)

AUTOMOBILE fan belts that have a tendency to "run off" are a continual nuisance. Generally the trouble is due to defective belts or to the pulleys' being out of line. The belt usually will stay on the pulleys and give no trouble if lower pulley is crowned a trifle, that is, if the diameter at the center is made somewhat greater than the diameter of the edges.

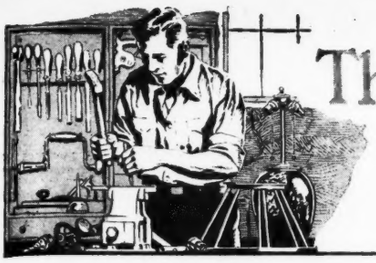
From an old inner tube cut a piece about ⅜ in. in width. This rubber, which should be endless like an elastic band, is stretched over the lower pulley after the pulley has been coated with rim cement or gasket shellac, as shown in Fig. 7.

Care should be taken to see that the band is exactly in the middle of the pulley surface before the cement begins to dry. If the upper pulley causes trouble, it may be treated in the same way.

The rubber will have to be replaced in time, but it is easier to apply a new band than to replace a belt while on the road.

IF YOU experience difficulty in steering your car accurately when backing, a notch or other mark made in the under side of the rim, as shown in Fig. 8, may help.

Set the wheels exactly straight and then make the notch in the rim directly back of the steering post. You can then judge the position of the wheel more easily than when there is no fixed guide.—S. L. D.



The Home Workshop

Arthur Wakeling, Editor

Cheap Motor Drives Speedy Sport Boat

By George Arthur Luers
Automotive and Mechanical Engineer

LIGHTNESS and speed, cheapness and simplicity of construction are the outstanding features of this unique hydrosled.

It is a sport boat the home worker can make without any elaborate equipment or large outlay for material, and, once built, the cost of upkeep is trifling. It can be knocked down for transportation in an ordinary touring car or even a runabout, and both launched and beached without the use of skids or a marine railway.

The power plant is simply a Ford or other light automobile motor. This is used because it costs little and can always be obtained without difficulty, and not because it is a type of motor to be recommended for marine purposes. These engines are available at a cost of from $15 to $50, depending upon their condition. In many cases the only work required to put one of them in fair running order is to fit new rings and tighten up the bearings.

The design is a condensed plan of a somewhat similar hydrosled made for use on the smooth waters of the Potomac River. That one is much larger, however, and required an automobile engine of twice the horsepower of the Ford, so that the greater weight makes it necessary to use special facilities for hauling out the boat at the end of the season and storing it through the winter.

Three men can lift out the power plant from this smaller hydrosled because it weighs only about 250 lbs. The hull weighs about 200 lbs., including the seats and accessories. In fact, the boat, when disassembled, can be carried in an automobile by the simple expedient of stowing the engine inside the car and lashing the hull to the rear or above the fenders.

Twin rudders are used because some difficulty was experienced with the larger boat in an attempt to steer it with a single rudder. It was found that the steering could be corrected by changing the engine to one side, but, as this would unbalance the boat, the twin rudder device was adopted. In thorough trials it proved to be very satisfactory.

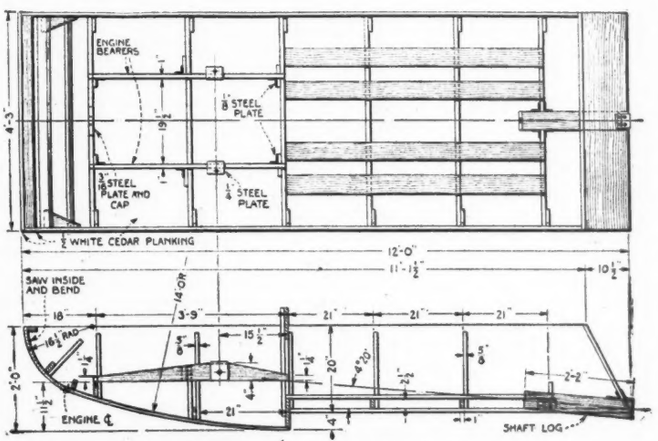
The single step in the bottom is used primarily to give room for the power plant, but it also follows the marine trend in providing a break in which the surface water is churned, with the result that the stern rides on bubbles or aerated water with less resistance than otherwise.

To cool the motor it is advisable to use a small circulating pump driven from the pulley on the crankshaft. A simpler but not so positive a method is to use the scoop illustrated to keep a quantity of water in the water jacket. A small valve in the bottom of the outflow pipe allows adjustments to be made in the flow to meet all possible conditions. The engine should not, however, be allowed to run for long periods when the boat is not in motion; otherwise the water will boil.

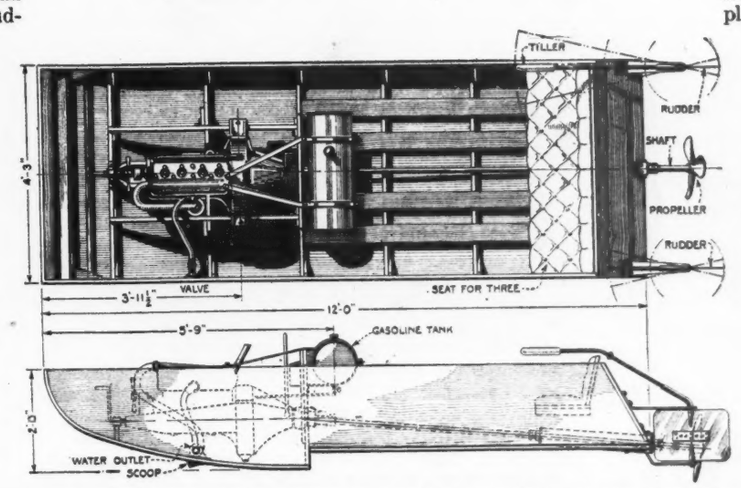
The driveshaft connection is modified, as shown, to allow a section of steel pipe to be attached to serve as the tubular propeller shaft, and a thrust ball bearing is made a part of the connection to take the propeller thrust.

The gasoline tank is mounted above the engine to provide the necessary gravity feed to the carbureter.

The general construction of the hull is made clear in the hull diagrams and is about as simple as could be devised. In fact, no steam bending is required for any of the surfaces, as bent work is usually more or less of a stumbling block for the amateur boatbuilder. It is advisable, however, that, in framing the hull, the builder obtain the assistance of some one who is familiar with boat construction, unless he has previously done similar work.



Diagrams of the hull, showing the general arrangement of the frame and engine bearers to secure maximum lightness and simplicity of construction without the use of steam bending



Top and side views of the completely assembled hydrosled. Note the steplike construction of the hull that gives a "planing" action and the twin rudders to insure control at high speed

The hull planking is preferably white cedar in widths of 10 or 12 in., if boards that wide can be obtained. The advantage of using the wider planking is that it lessens the amount of calking to be done. All the planking should be at least ½ in. thick. Cypress and spruce also can be used for the planking, and cypress has the advantage of being easily obtained and cheap. Cypress planking, however, should be ⅝ in. thick or more, well supported. It is important to use only carefully selected material, and see that the strength is not sacrificed at any vital point, as the hull is subjected to considerable strain.

The planking is run longitudinally. The bend at the bow is obtained by making a number of saw cuts partly through the planking on the inside. While this reduces the strength of the planking, no damage is done to the

(*Turn to page 105*)

How to Paint Decorative Home Furniture

By James S. Godfrey

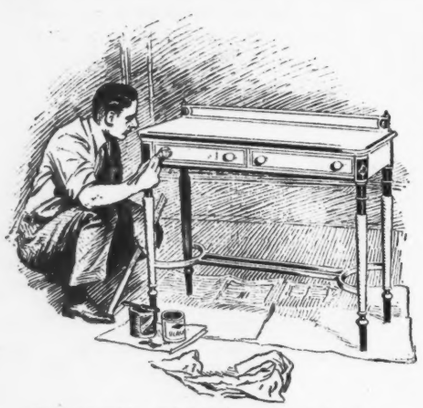
PAINTING furniture is rapidly becoming something of a national pastime. It is relatively easy to do, costs little for materials, and when done with good taste, adds immensely to the attractiveness of the average home. So great is its popularity that a considerable variety of new furniture in the "white" can now be bought, even in department stores, for the home worker to paint to suit himself.

Chief among the advantages of enameling your own furniture is that you can finish each piece in the colors and with the designs best adapted for the particular room and place in which it is to be used. The rich and original color effects that interior decorators obtain for wealthy clients by having individual sets finished to their own specifications are equally at your command.

Then, too, you can often save money by refinishing old pieces that perhaps have been stored in the attic for years or have been tolerated in the living rooms only because it would cost too much to replace them. The possibilities along this line are endless. One home worker, for instance, remodeled an utterly unpromising washstand, long obsolete, and gave it a vermilion under coat and a black finish, rubbed down to show the glow of the red beneath, transforming it to a cabinet that has the charm of an Oriental antique and is fit for a fine reception hall or music room.

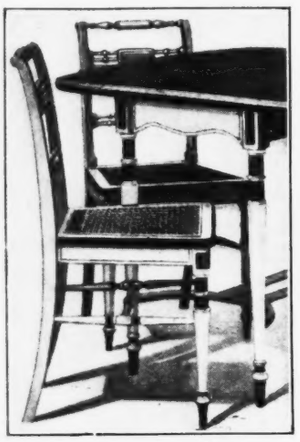
Wood or wicker furniture for the porch, breakfast room, and nursery almost invariably can be finished in enamel to good effect, since the pieces lend themselves to light tints and bright ornamentation. Bedroom sets and many odd pieces can also be enameled, if the colors are chosen with discretion, if the finishing is done carefully, and the banding, stenciling, or other decoration well considered and harmonious.

Enameled furniture lends itself naturally to painted borders and ornaments. Provided the colors are harmonious, it does not take much decoration to lend distinction to a painted piece.

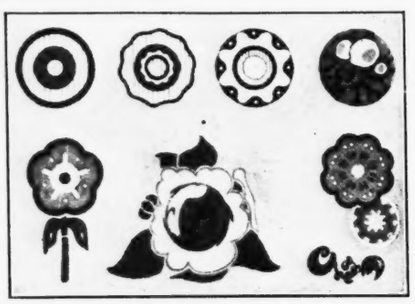


Serving table with black and red decoration on Pompeian blue and gold

Often the style of the furniture suggests where the color should be applied. For instance, the foot of a bed, as at *A* in the drawing in the lower right-hand corner, might have flat panels of a contrasting or harmonious color, either lighter or darker than the body color, as shown. At *B* the flutes in the posts of the dressing table offer natural grooves into which to flow stripes of color. At *C* the edges of the drawers are painted and a similar border line placed on the top of the posts. A small center ornament adds interest to the drawer fronts. A molded table top usually can be painted in several different ways, one of which is shown at *D*. Other methods of lining out and tinting drawer fronts are indicated at *E* and *F*.



Two examples of commercial painted furniture and a selection of simple designs in the modern style such as the home worker can invent for himself



For more elaborate ornaments it is possible to obtain stencils in hundreds of different styles and sizes at art stores and paint shops. Animal figures for nursery pieces, as well as floral and geometrical motives for general use, can be had.

Transfers, or decalcomanias, as they are technically called, can be obtained surprisingly cheap if purchased in full sheets containing a number of duplicates of the one design, and to apply them is simplicity itself. It is not always easy, however, to find a place where they are sold, although they can always be ordered by mail from the manufacturers. The child's bed shown on another page is decorated with decalcomanias.

Make Your Own Decoration

Usually it is better to get up an original design and cut a stencil or stencils for it, as described in detail in an article on page 78 of our February number. It is sometimes even quicker to transfer the units one at a time with carbon paper or by means of a pattern to the surface and paint them the desired colors.

The more modern styles of painted furniture often make use of bold and colorful ornaments that are not at all difficult to prepare. Even a circle can be broken up with a few lines, as shown above, and developed into an interesting ornament in the new style, provided colors are chosen that go well together.

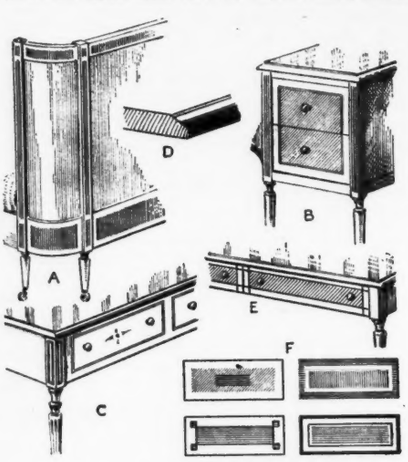
The secret of success in enameling lies largely in the proper preparation of the surfaces. The unfinished furniture sold for enameling, or any pieces that the home worker makes himself, are usually whitewood, poplar, birch, gumwood, or other close grained woods. Open grain woods, such as oak, chestnut, and yellow pine, are hard to finish smoothly in enamel, but are sometimes used in connection with novelty finishes.

If you have unfinished pieces with which to deal, the first essential is to see that the wood is as smooth as it can be made by scraping and sanding. A little additional labor spent in this will be more than repaid by the time saved in later steps, as well as in the more satisfactory results. The amateur's tendency is to rush through the preliminary steps.

When you buy the enamel you intend to use, obtain at the same time the under coat that is recommended for use with it. It sometimes happens that you cannot obtain just the color you desire. In fact, some high grade enamels are sold in only a few colors. You can, however, tint white, cream, gray, or other enamels with oil colors in tubes such as are sold for artist's use. Mix turpentine with the oil color until it is like a thin paint, and then add a little at a time to the enamel, stirring it well, and testing until the tint or shade is what you wish.

Under coatings are necessary to build up a good surface for the enamel, which is somewhat transparent, and they are, of course, cheaper than the enamel. The first or priming coat is often thinned with a little raw linseed oil. It should be well brushed into the wood and allowed to dry for 48 hours.

Any puttying that is necessary should next be done and two or three more under coats applied, usually at full strength or thinned a little with turpentine. Each coat should be allowed to dry at least 24 hours and should be sanded lightly and dusted.



Decorations that take advantage of the natural "breaks"

The under coating should be approximately the color of the finishing enamel and,

(*Turn to page 109*)

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Our book tells how to refinish woodwork.

Also tells about finishing and refinishing old furniture and woodwork.

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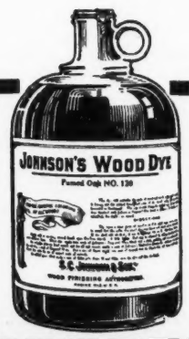

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Spanning Continent with a Two-Stage Set

This Novel Radio Receiver Contains Bank Wound Tickler Coil

By Loyd B. Gangawere

BEFORE entering into a description and giving the hook-up of the coupler of my radio receiving set, I wish to give a brief outline of what has been accomplished with several of these tuning units now in use.

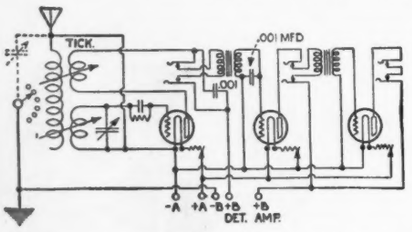
I have built five of them and they are all uniformly good, because all have at one time or other picked up KHJ at Los Angeles, Calif., from Pennsylvania, 40 miles from Pittsburgh. I have heard him myself, with one stage, five times within three months. The owner of one set, using two steps of audio frequency on six-volt tubes, claims to have heard that station at a distance of 30 feet from his loudspeaker.

Three of the couplers are being used with 1½-volt dry battery tubes and the other two with six-volt tubes.

The set cannot be beaten for selectivity, I feel confident, and the signal strength of distant stations is exceedingly good. I have 100 different broadcasting stations entered in my own log book. These stations are scattered over 26 states and Canada, and one station in Cuba. I have picked up 30 different stations, one after another, in an evening, 20 of these while KDKA, 30 miles away, was going full blast.

The accompanying sketches make only a brief description necessary. The rotors should be about 3½ in. in diameter, and the space on each side for wire should be about ⅝ in. wide. The wider rotors do not give as good results.

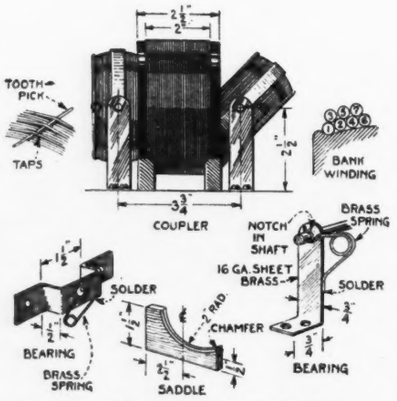
The tickler is bank wound with No. 24 d.c.c. copper wire. Put on as many turns as the rotor will accommodate, two layers deep. I have found that there is very little,



The hook-up preferred by the author

if any, difference between coils having 90 and 125 turns.

Be sure, however, that your coil is bank wound; the sketch shows how the winding is applied. Beginning at the outer edge of the rotor, wind two turns; carry the third



Details of the tuning unit with its two rotors, one of them bank wound

turn back on top of and between the first two; drop down beside the second turn with the fourth; place the fifth beside the third, and so on across the one side of the rotor. When the middle is reached, the wire is cut off and pushed through a hole into the middle of the rotor.

The other side of the rotor is then wound the same way, beginning at the outer edge and winding toward the center, and the end is pushed through another hole. The ends of the two half windings are soldered together. Be sure to wind the second half so that the winding will be in the same direction as the first when the halves are soldered.

The secondary is a single-layer coil with 25 turns on each side. The outer ends of the wires in each case are carried through holes to the inside of the rotors and are soldered to the ends of the short shafts, of which there are two for each rotor. The ends of the shafts project slightly on the inside.

A Good Job of Tapping

The primary consists of an insulating composition or shellacked cardboard tube 4 in. in diameter, 2½ in. long, wound with No. 22 d.c.c. or s.c.c. wire, tapped every five turns. A good job of tapping may be made by winding four turns on the tube, then laying a toothpick or sliver of wood diagonally across the winding and the unwound part of the tube, carrying the fifth turn over it, the next four under, the next one over, and so on across the tube. The raised wires will be found very convenient for soldering the connections, and the winding will be neater and tighter than is possible when taps are made by twisting out loop leads.

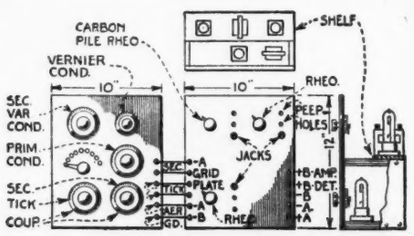
In wiring the set, the connections with the secondary and tickler are made by soldering springs to the bearing standards, as shown.

While this coupler works very well with almost any tickler hook-up, I am describing the hook-up that seems to me to give the best results. It is very selective and not particularly critical as to either plate or filament voltage. With my dry-cell tubes I have used all the way from 15 to 100 volts across the plate, generally using the higher plate voltages on the nearer stations.

Referring to the hook-up, you will note that I have shown a .0005 variable condenser across the primary. This is not necessary, but is an aid in tuning. The secondary variable condenser has a capacity of about .0005 mfd. and should have a three-plate Vernier shunted across it when fine tuning is desired.

The .001 fixed condenser across the primary of the first transformer (or the phones, in case a detector only is used) seems to be a necessity if you wish to reach out long distances, while the condenser across the secondary is only of slight advantage, and may be dispensed with.

As to the arrangement of the set on the panel, the builder can suit himself. I have mounted several sets without primary condensers on 6 by 24 in. panels, placing the coupler at the extreme left of the panel with the switch on the center line between and above the coupler dials. The secondary condenser is placed about 4 in. to the right of the secondary knob, and the rheostats and jacks occupy the right-hand end of the panel.



Panel layout for changing hook-ups easily

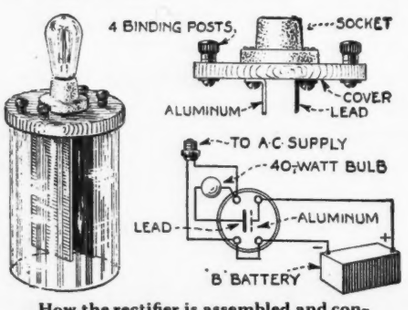
For any one who wishes to try various hook-ups, the two-panel layout shown is excellent. It is only a matter of a few minutes' time to change to any hook-up desired, as all the needed connections are brought out to binding posts. For experimenting, this is just as convenient as a board mounted set.

Rectifier for Charging Radio B Storage Batteries

By Kenneth M. Swezey

ALL storage batteries require direct current for charging. In most city homes, however, alternating current is found because it can be distributed by the electric light companies more easily than direct current. Therefore those who have radio sets or other appliances requiring small storage batteries have to carry their batteries to a charging station, unless some means is provided for rectifying the current at hand.

Rectifiers of the Nodon, or electrolytic, type are the easiest for the amateur to construct, although not very efficient for any but the smallest currents. Radio B batteries, or other batteries requiring but little current, can be readily charged with the rectifier to be described. The parts can be assembled at small expense and with little difficulty.



How the rectifier is assembled and connected for charging a small radio B storage battery

The exact size of the parts used is not of great importance, but the dimensions mentioned can be followed to advantage. Obtain a battery jar or other jar, 4 in. in diameter and 6 in. deep; one strip each of lead and aluminum about 1/16 in. thick, 2 in. wide, and 6 in. long; 4 binding posts; a

(*Turn to page 114*)

THINK of your Radio receiving set as a kind of camera whose "film" is sensitive to *sound* waves instead of *light*.

Developing this "film" into real "sound pictures" is the whole art of Radio usefulness and enjoyment.

For this, no apparatus has ever been evolved which gives results equal to those produced by Magnavox Equipment.

R2 Magnavox Radio
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This instrument is intended for those who wish the utmost in amplifying power; for clubs, hotels, dance halls, large audiences, etc. It requires only .6 of an ampere for the field. Price **$60.00**

R3 Magnavox Radio
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As illustrated

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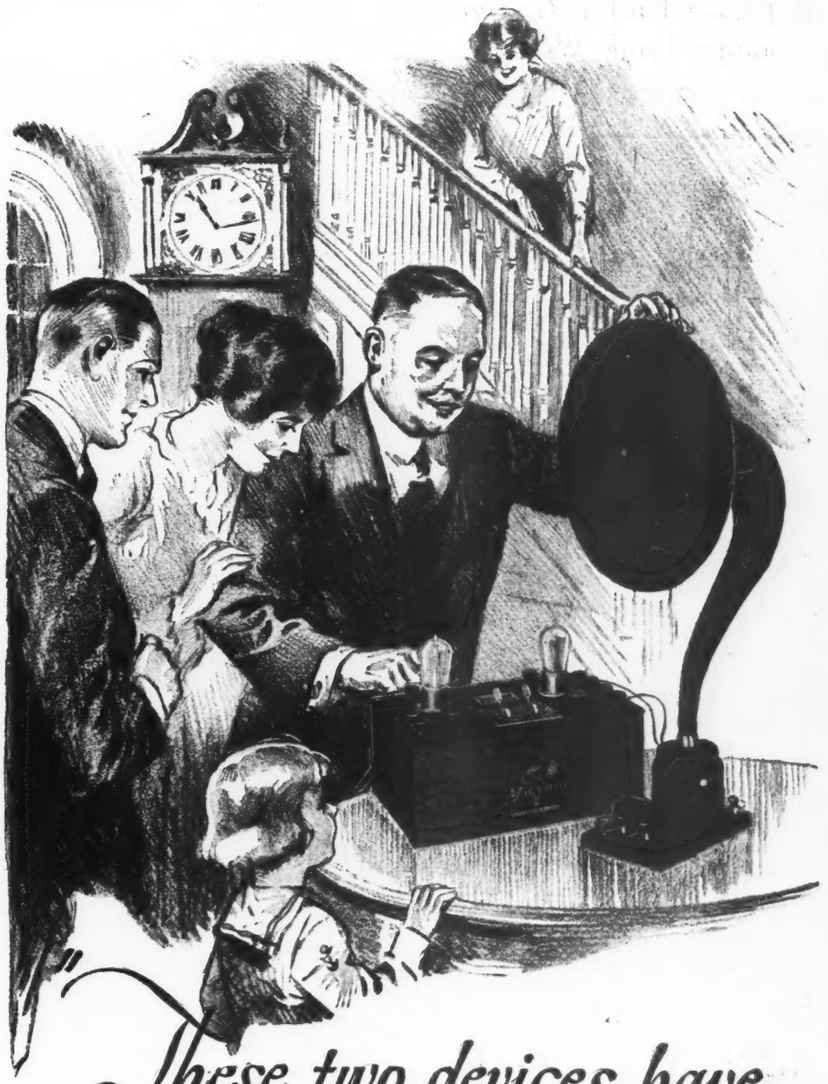
Magnavox Reproducers and Power Amplifiers can be used with any receiving set of good quality. Without Magnavox, no receiving set is complete.



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The Reproducer Supreme

Better Shop Methods

How Expert Mechanics Save Time and Labor

How I Rose from $2.50 a Week to $300 a Month

By J. Edgar Mitchell

Huntsville, Ala.

(Awarded First Prize of $30 in POPULAR SCIENCE MONTHLY'S Contest, "How I Got that Better Job")

J. Edgar Mitchell

IN MARCH, 1903, I launched my career with the Central Foundry and Machine Works, an enterprising concern; doing a general repair business, as well as manufacturing a line of woodworking machinery and gasoline and steam engines. I entered as a machinist apprentice at $2.50 a week with a $1 raise every six months.

My first aim was to be an efficient machinist, and my first job was cleaning foundry castings. Looking ahead, I began to wonder how a man could advance, and, after a few weeks' experience, I formed the following practical conclusions, which I still consider valuable in instructing my boys today.

1. Never pay too much attention to starting and quitting time. I have always considered it worth while to get to the shop in time to look over and plan my work for the day and I never neglected a job because quitting time was approaching.
2. Show a willingness to do things others dislike.
3. Find the quickest and best way of doing things.

Your time is valuable.

4. Learn your job first and then the man's ahead of you. You'll be apt to get it.
5. Never ask for a raise.

Qualify yourself, and your employer, if he is the right kind of an employer, will do the rest.

6. Keep a cool head at all times. You are certain to be "balled out" more than once.

With these ideas clearly in my mind I *worked* and observed as I worked.

On Sundays I would clean out the engine room and keep everything around our boiler and engine room in tiptop shape. The boss liked this and put me in full charge of engine and boiler. However, I had to do this work on Sunday.

I decided to paint the boiler front and all pipe lines one Sunday and when I got to the engine room, with a gallon bucket of paint on the ladder and the ladder on an oily floor, everything was blank for a few minutes and then everything was black. It was a job to get things in shape for Monday, but the boss admired my work and had a good laugh at my accident.

Later on I was put on machine work and I began to borrow the boss's books, learning all I could about tools and grinding them. I would often go over and sit with him evenings. Shortly I was put in charge of the apprentice boys, seven in all. I taught them how to grind their tools and how to get along without so much help.

"I began to borrow the boss's books . . . . Shortly I was put in charge of the apprentice boys"

Some of my jobs were hard and required a lot of thinking, and often I had to do them in quick time—hard ones, such as turning the main bearings on a large steam engine without removing the shaft from engine. I won a first prize by sending a sketch of this job to POPULAR SCIENCE MONTHLY in 1920, and a second prize for straightening a large steel connecting rod about 18 ft. long by heating and dropping on cross ties. Other awkward jobs were boring large flywheels in the engine room with a portable cylinder boring machine, and the babbitting of large main bearings with wooden mandrels and boring them with a portable cylinder boring machine.

After I finished my apprenticeship, I was appointed foreman and also received several raises in wages before they were due. About this time I began to receive flattering offers from other concerns and it was quite a temptation to accept them, but my training was not complete and hence my learning capacity not so much as it would become.

After remaining with this concern twelve years, I entered the automobile machinery business for myself. At present I am Director of Service for L. Schiffman & Co., Dodge Brothers' dealers for northern Alabama. I have had a wide range of experience and my salary has ranged from $2.50 a week to $300 a month, but the esteem and confidence that the machine world places in me and my judgment have been as well worth striving for as the better job.

Qualify yourself, render proficient service, and you will get that better job.

Wins that Better Job by Designing Worm Gears

By James Ellis

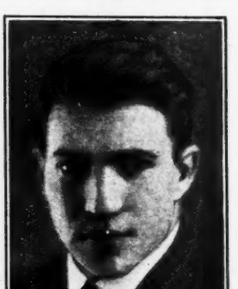
Memphis, Tenn.

(Awarded Second Prize of $20 in POPULAR SCIENCE MONTHLY'S Contest, "How I Got that Better Job")

MY OPPORTUNITY for a better job came in a small shop, as shops are measured today. The office force was one man, and he was the proprietor. There were three or four machinists, including myself. While our equipment was by no means new, it served the purpose well, and we had almost everything we needed.

The policy of the shop was to tackle anything that there was any chance of handling successfully. This was possible because we had only the best of mechanics and could find a way to do the things that the other shops would not try. That was how we happened to get the worm gear job; the other shops sent Hawkins to us.

Now, a worm gear looks to be a simple thing, yet the problem that Hawkins put up to us stumped all of us for a time. The boss went at the calculations as if it were a spur gear, and got along all right until it came to the threading of the worm. Old man Horace, to whom we put all the hard problems, tried it for half a day, but threw up his hands in disgust.



James Ellis

I remembered that in a handbook I had recently purchased there were several pages devoted to worms and worm wheels. That night I read them through and it was all clear as day-

(Turn to page 82)

Cunningham

the standard tube for all makes of receiving sets

Mutual Conductance
The Correct Rating for Vacuum Tubes

Gas Engines are rated by their horsepower—Electric Generators are rated by their watt or kilowatt output—Mazda Lamps are rated by their candle-power. All of these factors actually express the efficiency of the article for the purpose intended.

In the past vacuum tubes have been known merely as Detectors and Amplifiers. These terms indicated only the use for which the tube was designed, but in no way expressed its efficiency for either of these purposes. Though little known to the general public, there is a factor—MUTUAL CONDUCTANCE—which adequately and accurately expresses the efficiency of vacuum tubes. The new Cunningham C-301-A has the ***highest value of mutual conductance ever obtained in a receiving tube,*** and it is this factor that is responsible for its ***superior operation*** as an Amplifier.

For the assistance of the public, in obtaining true musical quality and actual reproduction in broadcast reception, this company will, from time to time, issue Service Bulletins explaining in a clear and simple manner the most important technical features that must be observed in the selection and operation of radio apparatus.

Cunningham Service Bulletin No. 1 explains the use of the fact or mutual conductance as the standard rating for vacuum tubes. The information it contains should be thoroughly known to every owner of a radio set who is interested in obtaining maximum efficiency with a given number of vacuum tubes. This bulletin will be mailed to you, free of charge, upon request.

Write for Bulletin 1-P explaining the uses and advantages of the term Mutual Conductance as the correct rating for Vacuum Tubes

Cunningham C-301 A Improved Amplifier Now $6.50

Filament Current ¼ Amp. Mutual Conductance—600 micrombos at 100 volts plate and 6 volts neg. grid potential

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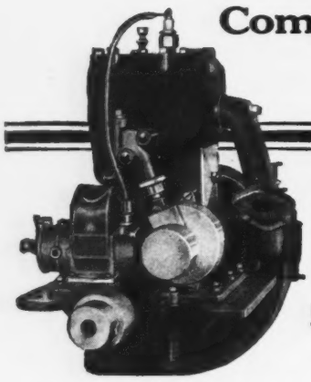

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Wins a Better Job by Designing Gears

(*Continued from page 80*)

light. I figured out what was wanted and drew it on a scrap of paper to show it to the boys in the morning. The boss was skeptical about it, but said that since I was the only one who was sure he was right, they would try my scheme. It worked, and I had the pleasure of explaining the method used.

This particular problem should have caused no trouble. It would not have been any trouble at all had we been a little more prepared for those things that are likely to come into any shop.

The center distance of the worm and its wheel was not fixed, although it was to be between 3 and 4 in. The inventor specified the pitch of the teeth, ⅜ in., and the diameter of the worm, 2¼ in. The ratio was to be between 40 and 45 to 1.

In arriving at the dimensions of the worm and gear I first laid out the worm and the given center distance on a sheet of paper. The diameter of the worm was given, so it was necessary to see if the desired ratio could be had with the given center distance. The pitch diameter of the worm was taken as 2 in., which gave a well proportioned tooth. The closest center distance, 3 in., gave a pitch diameter of 4 in. for the wheel, which, multiplied by 3.1416 and divided by the pitch, gave 33½ teeth. Not enough teeth.

The widest permissible center distance, 4 in., gave a 6-in. pitch diameter for the wheel, which would have been right for 50 teeth. About midway between would give the correct ratio and 3½ in. was selected as the center distance. This gave a pitch diameter of 5 in. and 42 teeth on the wheel, fulfilling all the requirements. A section of the worm wheel was carefully drawn, and the diameters for turning the blank were scaled from the drawing (Fig. 1).

Needless to say, my ability to give Hawkins his worm and gear put me in good standing with him. The machine he was developing required a number of worms and wheels in its makeup, so he would come to me for the data. I figured single thread and double thread wheels and even a triple thread wheel for him.

The boys in the shop would give me the laugh, though, when I would give Hawkins some figures and then in a few days he would come around the shop with a blueprint showing the worm and wheel I had figured, but with the notation in the corner, "John Hawkins, Engineer." Had I not been so young, this might have worried me, but I bided my time, and in the end was rewarded.

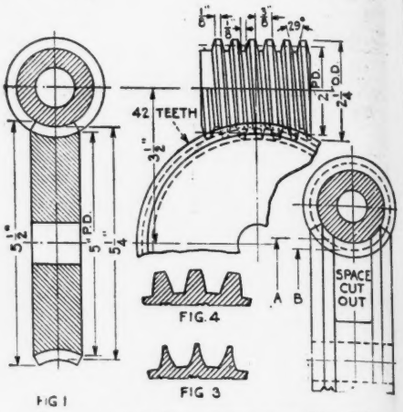


Fig. 1 is the first worm gear Mr. Ellis designed, and Figs. 2, 3, and 4 illustrate the tricky grooved gear

I was sent on a job that took several weeks. During this time Hawkins had ordered a wheel divided in the center, or rather, with a space where a rope could be wound (Fig. 2). I had explained my method carefully to the boys, so a wheel was made and the center portion then cut away. The result was anything but satisfactory. They had gone about the problem in the right manner, but had not put the pitch line in the right place! Figure 3 shows how the teeth looked. Upon my return I made one with the pitch line where it belonged (at *A* instead of *B*), and the teeth looked about as in Fig. 4.

Now, the result of all this was that when Hawkins felt that he should begin making his machines in his own shop, he came to me to take charge of the work. When I told the boys about my new position, which was considerably better paid, I asked them if they remembered when they laughed at me, and if they could remember the quotation about who laughs last.

Standardizes Tool Grinding System

By L. Malkovsky
New York City

(*Awarded Third Prize of $10 in POPULAR SCIENCE MONTHLY'S Contest, "How I Got that Better Job"*)

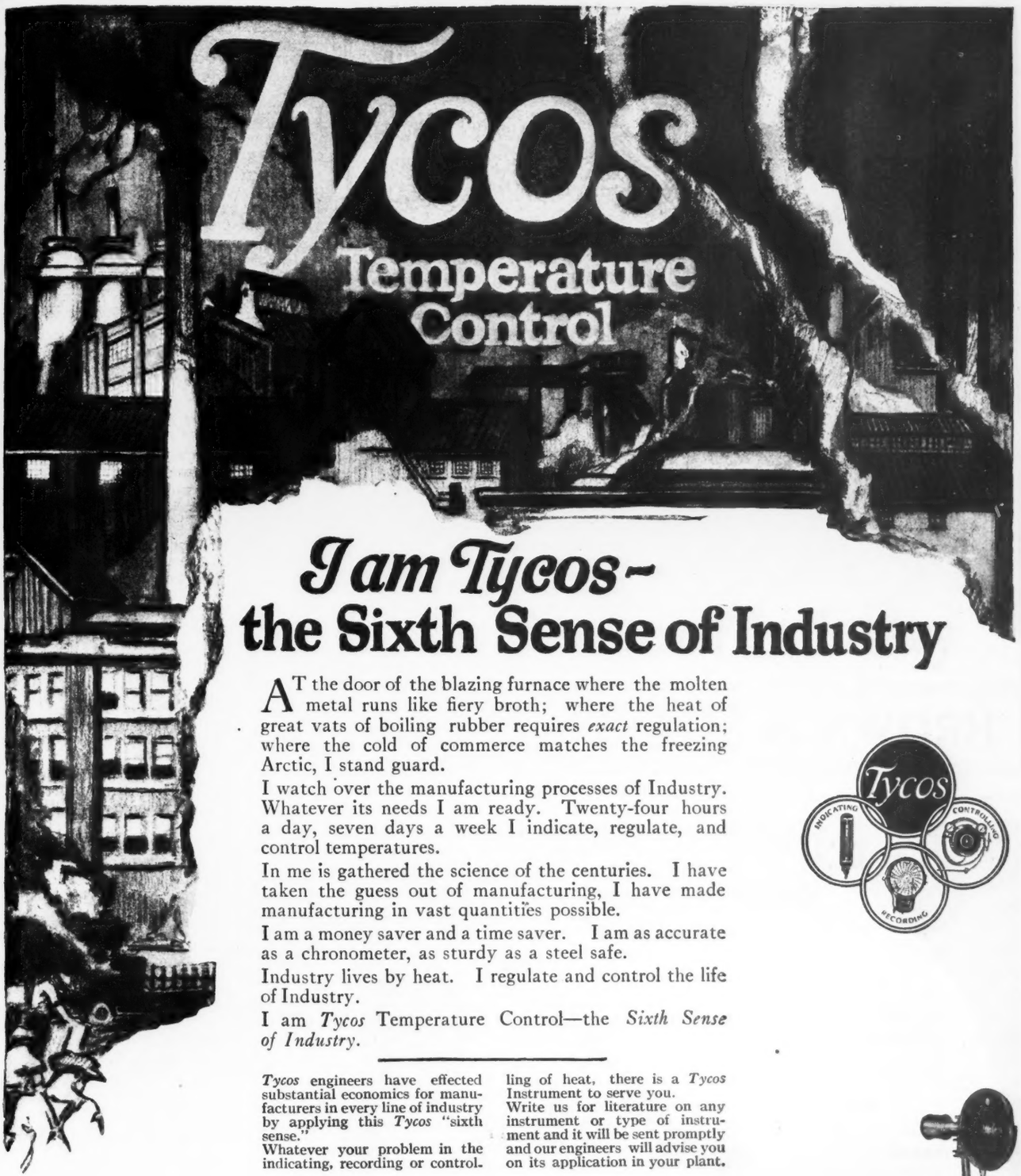
L. Malkovsky

AT THE age of 14 I started to learn a trade. I landed a job in a machine shop — exactly what I wanted. After serving a year or two, I was given machine work. The foreman, an old gentleman, was my chief instructor, and he used both hands and speech in training me in shop methods.

In a few months I thought I knew quite a bit about grinding tools. Unknown to the foreman, I had obtained from other men in the department some of their points on grinding tools and finally I was the master of about forty-nine different methods of tool grinding. This excess knowledge put me in such a bad fix that for a long time I got a chill every time some one mentioned tool grinding to me. Even today such differences in practice exist and my experience is that a surprising number of mechanics do not grind their tools to what is considered standard form.

Among the things I learned were that tools should be gripped as short as possible, set flat in the toolpost, and be on the center line of the work. If tools are below the

(*Turn to page 84*)



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AT the door of the blazing furnace where the molten metal runs like fiery broth; where the heat of great vats of boiling rubber requires *exact* regulation; where the cold of commerce matches the freezing Arctic, I stand guard.

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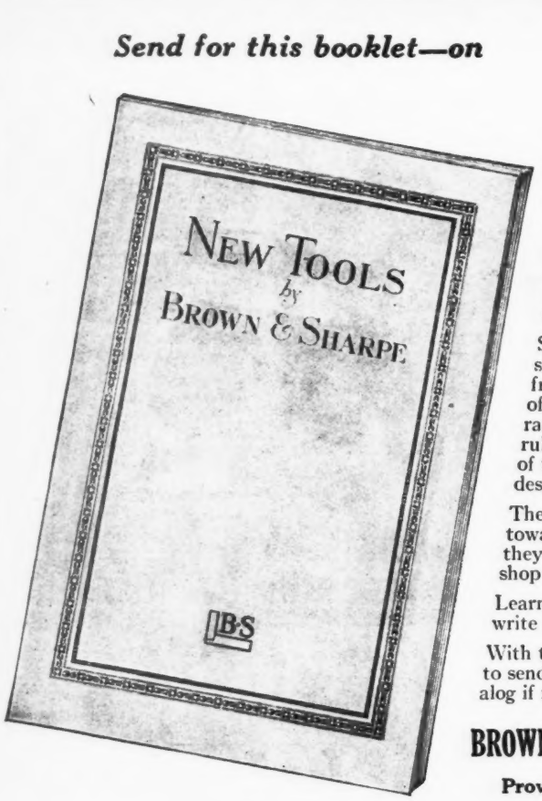

New Tools by Brown & Sharpe

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How to Select, Use and Care for Bits

BETTER SHOP METHODS

Simple Tool Grinding System

(*Continued from page 82*)

center line, they will spring and the metal will crowd on top and thus will cause chattering and undue strain on the tools.

Whenever possible, the tool should be so set in position that if it should move under the stress of the cut, it will move away from the work rather than into it, as shown in Fig. 1. This will save both the tool and the job.

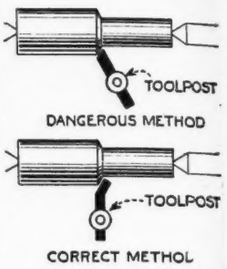


Fig. 1. Placing a tool properly

Some mechanics finish grinding their tools on the diameter of the grindstone, as at Fig. 2, but this leaves a weak tool. In defense of the practice they will argue that it is easier to keep a tool sharp by stoning it with an oilstone as well as cheaper than taking the tool out and regrinding it. I believe this to be an expensive method. The cutting edge has very little support, wears out rapidly, and often chips out. However, it is of some advantage in cutting soft metal such as Babbitt or white metal. Incidentally, finish grinding your tools on the sides of the grindstone.

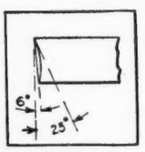


Fig. 2. Weak tool

To get the best results from a boring tool, the cutting edge should be on the center line of the body of the bar or a trifle above, as shown in Fig. 3. This also allows a larger body boring tool to be used.

Whenever new men are hired, it is customary to question them about grinding tools. They don't like this; in fact, tool grinding is a sensitive question with most of them. If you criticize the shape of one of their tools, they say they always have ground it in that way and obtained good results.

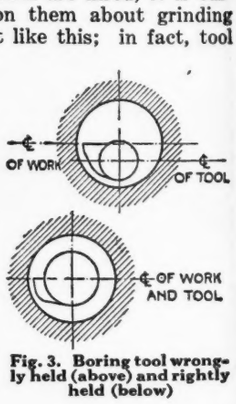


Fig. 3. Boring tool wrongly held (above) and rightly held (below)

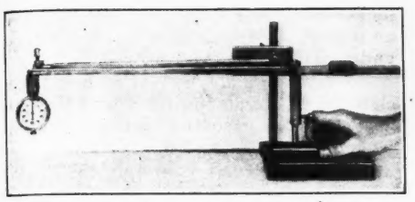
To overcome this difficulty, I laid out a tool chart with the shapes of tools and cutting and clearance angles for various materials. These tools are machine ground and kept in the tool crib. When a man needs a tool, he goes to the crib, selects the tool desired, asks for it by number and deposits a check for it. The men are instructed to try to follow the original angles and clearances in regrinding these tools so as to help in maintaining a standard form for the tools throughout the plant. When the workman returns a tool, it is expected to be in reasonably the same shape, but if it is changed in any radical way, the foreman is notified by the crib man, and this provides an opportunity for the foreman to give further instructions to the particular mechanic who needs it most.

Plain sense in working out this system was a big help in getting me a better position.

BETTER SHOP METHODS

Indicator Shows Changes of One Thirty-Thousandth Inch

BY MOUNTING a steel lever 22 in. long, as shown, I was able to show on an indicator dial deflections as small as one thirty-thousandth inch. In other words, if one end of a steel parallel was one thousandth of an inch thicker than the other, the indicator would register 30 points while



The work to be checked is pulled slowly under the testing arm of the indicator

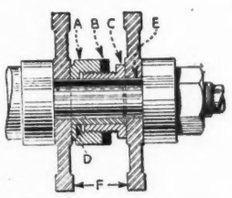
the block of steel was drawn beneath the hardened steel ball at the end of the adjustable testing rod.

The device is supersensitive for ordinary purposes, but permits quickly checking gage blocks with a master gage and similar work.—S. L. ROBERTS.

Adjustable Spacing Collar for Separating Milling Cutters

WHEN two slots have to be milled a certain distance apart at the same time, as is frequently necessary, the usual practice is to use spacing collars of solid construction between the milling cutters. Whenever the distance between the slots varies, a new spacing collar must be made.

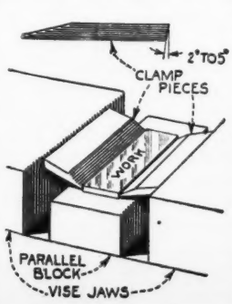
The need for making so many collars can be avoided by the use of one adjustable spacer, as shown. One piece, *A*, is threaded so that another one, *C*, fits into it, as shown. A locknut, *B*, completes the spacer. *D* is the center bushing on which the adjustable spacer revolves, and *E* is the key that keeps the cutters from turning. Simply by adjusting the nut, a variation in the distance, *F*, can be obtained, and this makes the spacer a valuable time and money saver in the shop.—J. H. MOORE, Toronto, Can.



An adjustable spacer

Holding Thin Work

WHEN the jaws of the shaper vise have become rounded on the corners through use, as is often the case, it is hard to hold thin pieces securely. This difficulty can be overcome by using two pieces of steel, shaped as shown.



When the vise is tightened, the two clamping pieces are drawn downward and carry with them the work, holding it securely on the parallel block or blocks. — R. H. KASPER, Philadelphia, Pa.

Since 1882 when L. S. Starrett first introduced a line of tempered steel rules, machinists and mechanics have always looked to Starrett for the latest and best improvements in rules and mechanical tools. You will find some thirty of the newest Starrett Tools fully described in the new Revised Supplement and Catalog No. 22 "W". Write for it—we will mail you a copy promptly at our expense.

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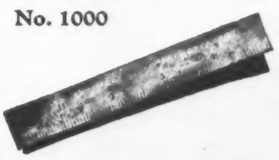

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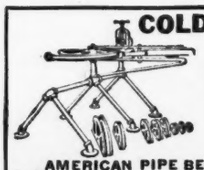

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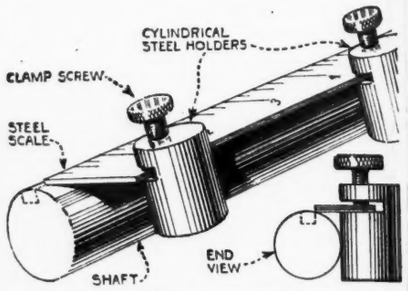
BETTER SHOP METHODS

Scale Holders Simplify Marking Long Lines on Shafting

A SCALE held in two simple fixtures, as illustrated, simplifies the work of scribing long lines on shafts for fixed or feathered keyseats or similar purposes. The scale or straight edge can be of any suitable width or length, and the attachments are two cylindrical sections of steel about 2½ in. long for ordinary work, and longer for large work. Each is slotted accurately at right angles to the main axis and tapped for a setscrew.

To lay off a keyway, the holders are clamped on a scale in such a way that they automatically gage the distance from the



These scale holders save time in scribing shafts for long keyseats

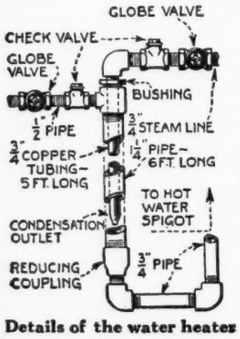
edge of the key slot to the outside of the shaft. This distance is obtained by dividing in two the shaft diameter, less the width of the keyway.

When the first line has been scribed, the second is obtained by setting the dividers to the width of the key, placing the tool at that distance on the opposite side of the shaft and scribing the lines. This method will serve for drawing an accurate line many feet in length.—G. A. LUERS.

Heating Hot Water in the Shop

A STEAM operated hot water heater for the shop can be made quite easily by any one who is handy with a pipe wrench. The construction is as shown.

The steam and water pressure should be about the same, so that the steam and water will enter the condensing chamber uniformly. Should there be more than 10 lbs. difference, the control valve on the steam or water is choked down in order to reduce the pressure.



Details of the water heater

The moment the hot water faucet is opened, the check valves on the steam and water line open; and when it is closed, they check against each other. There is, therefore, no waste of condensation and the condensing chamber never gets hot.

The device operates best in an upright position. If 1-in. pipe is used with ¾-in. tubing inserted inside, practically the same results will be obtained as when the larger pipe is used. A heater constructed in this way will serve ⅜-in. spigots.

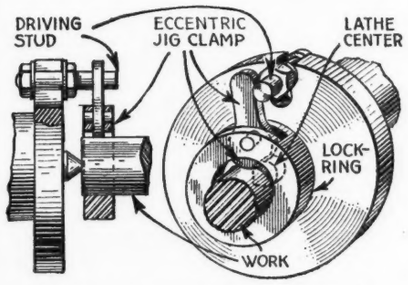
Several of these water heaters have been in constant use for a year and have proved quite satisfactory.—H. W. PARKHAM.

BETTER SHOP METHODS

Quick-Acting Dog Speeds Up Production on Lathe

WHEN a number of pieces of the same size are to be turned down in the lathe, the lathe dog illustrated will prove a time saver.

This one was made from a shaft collar, slotted and drilled to take the eccentric jig



No wrench is required for tightening this eccentrically operated, quick-acting lathe dog

clamp shown. The driving stud is a threaded piece of stock fastened to the face-plate with two nuts and washers.

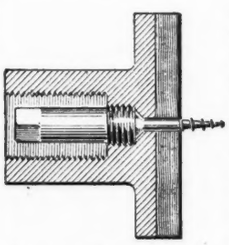
The operator does not need a wrench to tighten the dog or to take it off; the driving stud tightens the clamp on the work, and the heavier the cut the tighter the grip. When the work is finished, it is turned on the centers to clear the stud and a light tap on the clamp releases it.

The use of this dog has been the means of a piecework operator's increasing his rate materially.—S. A. McDONALD, Brooklyn, N. Y.

Screw Chuck for Wood Lathe

THIS screw chuck for wood turning has the great advantage that the screw always is held firm and true and can be changed in about a minute when it becomes worn or broken. Four of these chucks that I have made at various times for my own use have proved most satisfactory.

The flange of the cast iron attachment is 4 in. in diameter and ⅜ in. thick; the body of it is turned to a size to suit the collar on the lathe and threaded to fit the spindle loosely. The steel plug that holds the head of the No. 16 wood screw can be extended, if desired, so that the square head projects far enough to be turned with an ordinary wrench.



Section of chuck with renewable screw

Commercial chucks usually have a large screw tightened in place with a punch, so that when the screw becomes worn it is difficult to get in another screw and fasten it rigidly.—A. P. HOWELL, Pacific Grove, Calif.

Bending Brass or Copper Pipe

BENDING brass or copper pipe or tubing is facilitated by using a pipe tee attached to a length of pipe, which serves as a handle. The tubing is run through the tee, which serves as a bending tool.—F. B.

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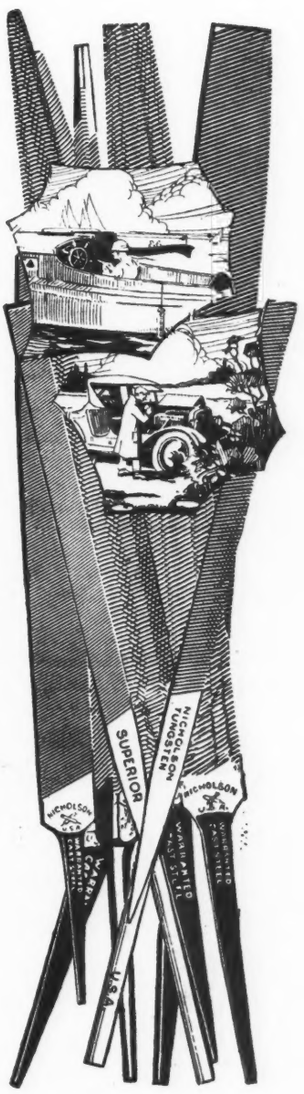

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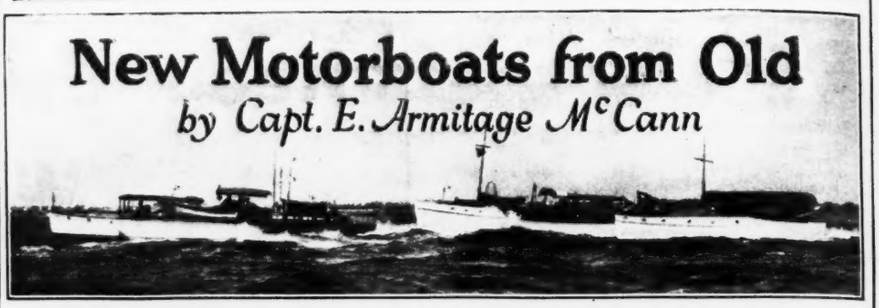

The second of the three articles of Captain McCann's instructive series

HAVING fixed up the stern of our dilapidated boat, as described last month, we shall now have a look at the bows.

The deck of this boat is level, except for the slight sheer rising to both ends; but she will look more comely and be a better seaboat if we raise the bows from 1 to 1½ ft. This will give them a good flare, so that when diving into a head sea, the boat will throw the water on one side, thus keeping it off the fore deck and from the cabin. Although a small boat, we want her to be able on occasion to go out to sea, no matter what the weather.

This will not be so difficult. First, the two upper planks will have to be removed to the nearest butts, or, if there is none handy, to where joints can be made. Save these pieces to replace, or, if in bad condition, to use as patterns for new pieces.

Next, the stem will be lengthened by scarfing on a new piece of oak as shown at 1 in the illustration on the next page. The top part of the joint starts below the deck level. The stopwater, shown at 2, is hardly necessary here but is useful in underwater joints that cannot be satisfactorily calked. It consists of a hole bored across the crack of the joint and filled in with a soft wooden plug, which swells and prevents leakage.

This piece must be very firmly bolted on, the boltheads being countersunk on the outside and the holes filled with wooden dowels. Always use washers under all nuts.

Extension ribs will now have to be cut. Make the after pair first, fix them in position by bolting them to the existing frames (ribs), then tack some laths onto the stem and the ribs on one side, to get the desired shape for the flare, and, using these as a mold, cut templets from thin wood at the positions the intermediate frames will take. From these templets cut your frames from oak in pairs. It does not pay to make these frames by hand; get some one with a jig or band saw to cut them for you. See that they extend well down the old frames to which they are to be bolted.

The old planks will now be replaced and the rest of the sides built up. This is not too easy a job, but with the aid of some thin wood for patterns and a steam box, any amateur can do it. Divide the height of the last frame into the number of planks to be used, according to their width, divide the space on the stem into the same number of parts, tack a piece of thin wood on the outside of the last plank laid, mark off on it the line of joint and the depth fore and aft, as at 3, Fig. 2, and from this cut your new plank. Unless it is very flexible, it will have to be steamed before it will go on.

The simplest form of steam box, as at 4, is four planks some 2 in. thick by, say, 7 ft. long and 12 in. wide. Nail these together in the form of a box, but before putting the last plank on, nail some light battens across the inside, so that two or more planks may rest on them, allowing the steam to circulate. From two short ends make plugs to fill in the ends, one to be removable. Calk all the joints.

Get a piece of flexible steam pipe of a size to go over, or in, the bunghole of an old oil drum, the other end fitting into a hole in the bottom of your box. Fill the drum two thirds with water, and place it over a fire of any kind, the steam box being supported over it and the two joined by the steam pipe. Leave the plank to be bent in the box from one to two hours, according to thickness, meanwhile shaping the plank for the other side in a similar manner.

On examining the ends of the other remaining planks where they meet the stem, we find that some of them are rather shaky and many of the nails do not hold, but that they are not bad enough to need removing, if we can strengthen the joints.

There is one plank, however, that is split away back; it will have to come out. So we cut it away from the stem, not minding how much we maul it, so long as we do not harm the stem or neighboring planks. Then we ease it away from the planks above and below, being careful of the ribs as we proceed. That is, if it is fastened with turned over nails, we straighten them or cut the ends off, drive them back and remove them before doing any prying. If this plank has a butt, we will go back to it; if not, we will make one, remembering that a butt always comes just between two frames, and that one must not be above another unless

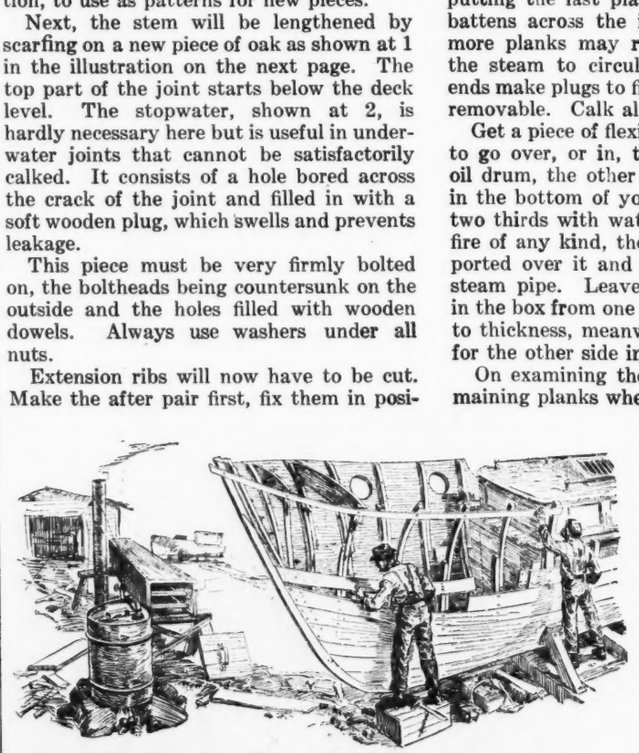

Fig. 1. The bows are raised by splicing a new piece to the stem, adding extension ribs and planking. Note the homemade steam chest at the left

there are at least two planks between.

The detail at 5 shows the method of cutting a butt in fairly thin planks. The two ends are fastened and a saw cut is made through both planks where they overlap; this ensures their meeting evenly and leaves just enough space for calking. Behind the butt there is a strengthening piece of oak from frame to frame, the depth of the plank and about the same thickness. To this both ends are securely nailed or riveted.

Having put in this and any other planks required and completed building up the bows, we will strengthen the stem joints with a facing piece, as described last month, and shown at 6 in Fig. 3 on page 96. It fits snugly onto the stem and the ends of the planks, thus binding them together. A heavy piece of tarred paper may be placed with advantage under it, and in fact this is a good plan to adopt

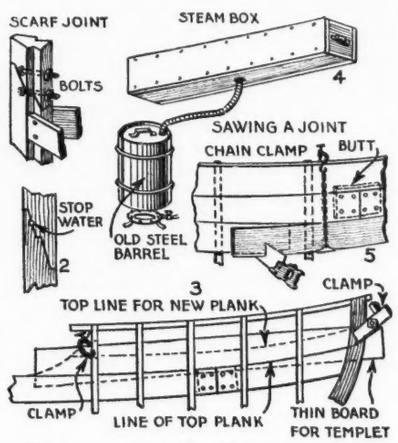

Fig. 2. How to splice the stem, make a water-tight joint, construct a steam box, and lay the planking

with all joints; it keeps water out and is a preservative.

If there is any doubt about the stem being strong enough to stand the buffeting of the sea and possible knocks into docks and other craft, a piece of oak may be fitted inside the stem and the planks nailed to it before putting on the outside plate. If the stem is in pretty good shape, a piece of brass shaped to fit round the bow and screwed onto the ends of the planks may be sufficient.

Our boat has a number of loose looking butts. In the majority of cases this is only protruding calking, which we will dig out and then rub some paint in and recalk. Where they seem shaky, they will have to be fixed up. As a rule, a few brass screws will accomplish this, or possibly a piece half lapped over the butt will serve; but to do this you will either have to remove the nails or punch them halfway through the plank, reclinching on the inner side. The half lap should be about half the length of the strengthener inside, as at 7, Fig. 3.

The diagram at 8 simply shows the usual construction of a stem and the joints to watch carefully for signs of rot. Another detail always to be observed in connection with stems is the shape of the rabbet for the ends of the planking, shown at 11.

Every seam will have to be tested and recalked after all loose paint, putty, and cotton or oakum have been dug out. Spun cotton can be bought for this purpose and is the best for small boats.

The butts must be calked first. Sufficient

(*Turn to page 90*)

Fun,—with Education!

There's nothing like having a "hobby" when it leads to worth-while results. The use of Tools gives you that mental rest so necessary after hours of hard study. The training of doing well any job you tackle is admirable discipline. The use of Good Tools is bound to make a good craftsman.

Stanley Tool Assortments

The same tools that carpenters have used for years are now sold in Cabinets, Chests and Boxes. No. 904 Cabinet is shown here. Ask any hardware merchant to show you this cabinet, or write for Folder "7-F" illustrating many Stanley Tool Assortments.

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"Red Devil" Pliers made in 100 styles—one for every need. Known and used the world over. Style No. 1024—6½ inch shown above, $1.00.

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THE "RED DEVIL" cuts twice as fast as ordinary auger bits.

You don't have to push the "Red Devil" Bit to make it go through a piece of oak as quickly as an ordinary bit will cut into soft pine.

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The "Red Devil" Auger Bit saves time because it cuts fast—won't clog—bores straight and true with or against the grain of any wood.

"Red Devil" Auger Bit No. 2400—made in 20 sizes, from 3/16 to 24/16ths. On sale at all good hardware dealers. If not in stock, send dealer's name and 75c for a sample bit No. 2400, size 10/16ths.

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"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown below, 20c

New Motorboats from Old

(*Continued from page 89*)

cotton should be used in the first place to fill the seam to about half its depth. If the seams are at all wide, this is done by looping the cotton as you go along, as at 9. Having made a firm bed of this, the cracks should be given a coat of paint and then puttied level with the surface. Only the best white-lead putty should be used, and if it is required to dry very quickly, a little

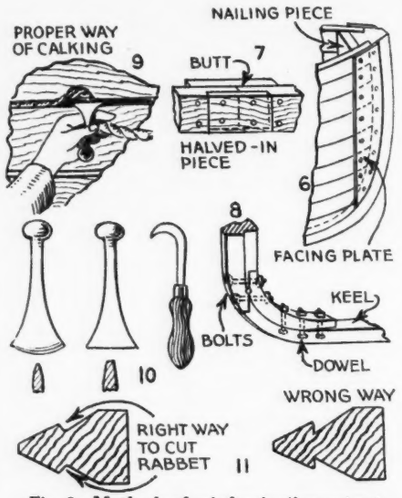
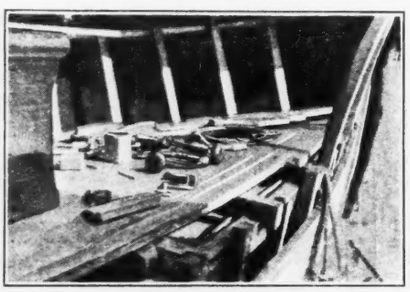


Fig. 3. Methods of reinforcing important joints, rabbeting the stem, and calking

coach painter's japan may be added, but it is better without.

It is worth while to borrow or buy two calking tools and a mallet. One iron is sharp, for opening the seams, if necessary, and to put in the cotton; the other is flat on the edge for preparing a flat bed for the putty. Another iron, shaped like a hook for taking stones out of horses' hoofs, will be needed for scraping the seams clean. (See 10.)

That should complete the outside of the hull, with the exception of scraping and painting. That may well be left until the last, unless the paint needs burning off, in which case it should be done first and the wood given a priming coat to keep out the weather. Never burn off good, smooth paint, as it is a preservative, but if it is



How the raised bows look before the planking is nailed in place

badly blistered or broken, nothing will serve but burning it off or removing it with a paint remover, which is a tedious job if the paint is thick.

Now let us finish off the bow by putting a skin or lining on the inside of the raised part. This will be thin wood neatly fitted onto the inside of the extended frames and to the inside of the stem, with a flat piece

(*Continued on page 91*)

A New Vision in Development Work

The inventor, patiently watching the performance of a new machine, tries o e expedient after another for bettering its rate of production.

Every noticeable gain registers on his mind—but more surely and precisely will it register on a *Veeder Counter.*

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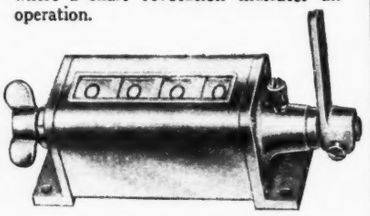

Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list). Smaller counters at prices from $2.00 up.

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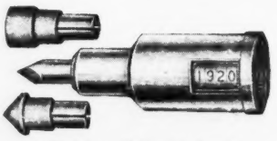

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The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

New Motorboats from Old

(Continued from page 90)

having rounded edges along the top and down the after end to the gunwale.

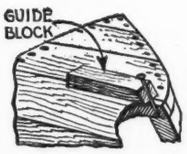
If more work can be done on the boat, it is better to cut the existing deck away at the level of the fore end of the cabin, erecting there a bulkhead, and rebuilding the deck at the level of the top of your new ribs. This will make a roomy extension to the cabin and, forward of that, a locker for the chain and stores. If this plan is adopted, it will be necessary to cut one or more portholes for light. The rims to hold the glasses, whether to open or not, had better be bought ready made.

As an addition or alternative, a little skylight can likewise be bought or made to set on the deck. If made, it will have to be a very nice piece of teakwood or perhaps mahogany joinery, as it must be strong, easily opened, yet watertight when shut.

It is getting dark, so we will go home with a good appetite for supper, and in the next issue attend to the inside fittings and such like of our little ship.

The third and last article in this series will appear in the July issue.—THE EDITOR.

Nailing Angular Joints



The block serves as a nailing guide

WHEN building a small, flat bottom duck boat, I found it quite difficult to nail the bottom boards without having the nails go through one side or other of the thin planking. To overcome this, I cut a piece of 2 by 2 in. stock at one end to an angle equal to the angle made by the sides and bottom. Then, by holding the nail against this angular face, as shown, I was able to drive it in without a mishap.

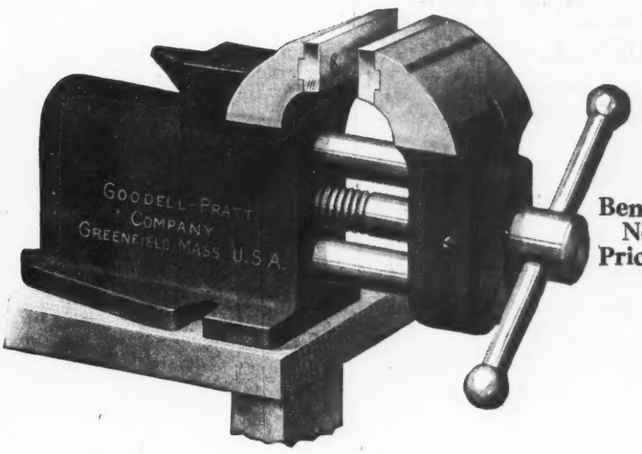
This idea can be adopted for any work where nails must be driven accurately at an angle.—ARTHUR M. SAMP, Milwaukee, Wis.

Spring and Paddle Keep Cement and Enamel Cans Covered

This lid keeps volatile liquids covered

CANS of tire cement, enamel, shellac, and other expensive fluids are fitted with lids to prevent evaporation, but the lids are apt to be forced off by the pressure of expanding vapor. A simple means to prevent this is to use a coilspring and prop, as shown in the accompanying illustration, at the rear of the bench or shelf on which the cans ordinarily are placed when left overnight or when not being used.

Holes are drilled at heights to suit various containers and of a size to take rather loosely the small end of a paddle shaped piece of wood. The coiled spring holds down the paddle firmly on the lid, and, if the lid is missing, the wood itself will serve in place of it.—S. M. C.



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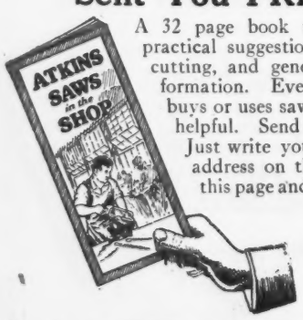

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THE HOME WORKSHOP

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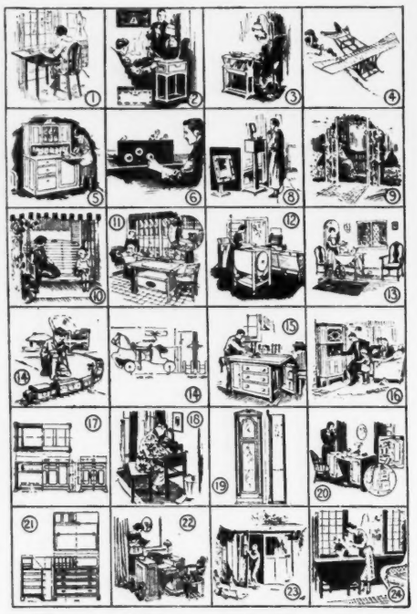
WHENEVER you are planning a new project in your home workshop, it will pay you to consult the ever-growing list of POPULAR SCIENCE MONTHLY blueprints. These represent the finest, clearest, and most practical set of working details for the home worker that has ever been published.



Thumbnail sketches of the Home Workshop projects for which blueprints have already been issued. See coupon below.

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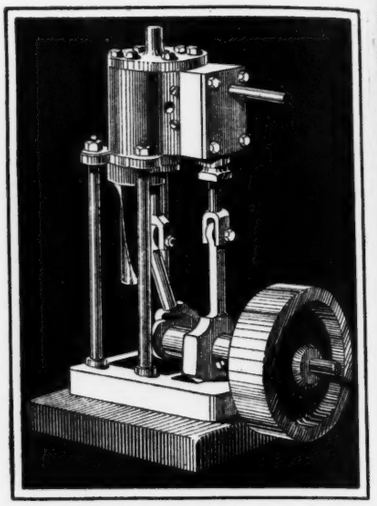

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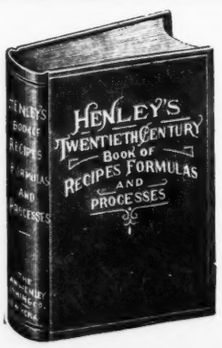

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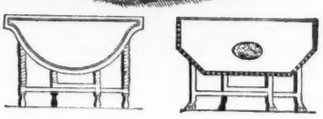
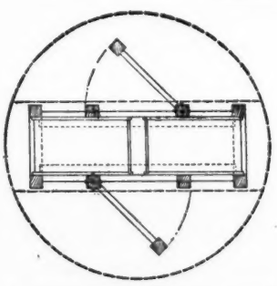
THE HOME WORKSHOP

Building a Gateleg Table without Difficult Cabinet Work

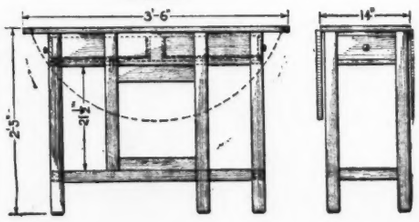
THE building of a gateleg table is one of the most interesting problems in furniture construction the home worker can undertake. It does not involve any particularly difficult cabinet work and the finished table almost always has a decorative quality that is in excess of what the builder expected.

Few types of table, indeed, combine so well the useful and the decorative as gate-





Gateleg table as simplified for construction in the home workshop



leg tables. They serve particularly well in odd places as occasional tables. Enameled in light colors, they lend a gay and cheerful note to the porch, sun parlor, and breakfast room; finished in the natural wood, they grace the living room, reception hall, and sewing room.

In construction a gateleg table is much simpler than appears at a casual glance. Not much experience is required to make one, especially if it has plain and substantial lines like that illustrated—a table especially designed for the Home Workshop series of blueprints by Mr. George F. Kaercher, of Philadelphia, one of the regular designers for the Blueprint Service. Mr. Kaercher has been a furniture factory superintendent for a quarter of a century and brings a lifetime's experience in woodwork to bear on the preparation of designs such as this.

If made of hard wood, such as red gum,

(*Turn to page 94*)

A telephone personality

In your face to face contacts with people, your appearance, your bearing and many other things help you to make the right impression. But in your telephone contacts there is only one thing by which you can be judged—your speech.

An effective telephone personality is to-day a business and social asset. Everybody appreciates the person who speaks distinctly and pleasantly, neither too fast nor too slow, with a clear enunciation of each word, with lips facing the mouthpiece and speaking into it. In business, this is the telephone personality which induces favorable action on the part of the listener. To the salesman it may mean the difference between an order and no order; between an interview granted and an interview refused.

Curiously enough, people who are careful to make themselves effectively heard and understood face to face, often disregard the need for effectiveness in their telephone speech. Perhaps they shout, perhaps they mumble, perhaps they hold the mouthpiece far from their lips. And frequently they never realize that their carelessness has defeated the purpose of their talk.

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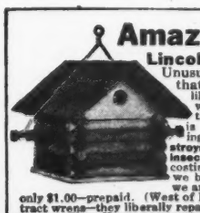

Unusually attractive bird house—that ONLY wrens can use. Looks like a miniature log cabin. Made of wood, tinted a soft brown color that attracts the wren, whose song is melodious and flute-like; amusing ways make it a favorite. It destroys large numbers of obnoxious insects. The equal of wren houses costing $5.00 to $7.00. And yet because we build in tremendous quantities—we are able to sell, knocked down, for only $1.00—prepaid. (West of Denver and Canada, $1.25.) Attract wrens—they liberally repay attention. Send $1.00 for each Lincoln Wren House you want. If you aren't delighted—money back. Write now.
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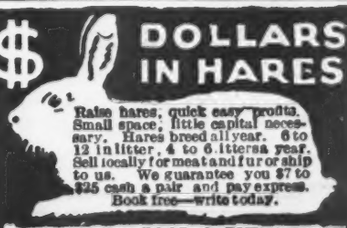

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THE HOME WORKSHOP

Building a Gateleg Table

(*Continued from page 93*)

birch, or one of the more expensive cabinet woods, the table can be given a natural finish, but it is especially suitable for a painted finish. In that case it is made of whitewood, poplar, pine, or other soft wood. How to paint to the best advantage such pieces as this is told in an article on page 76.

When extended, the round top is 3 ft. 6 in. in diameter and the table stands 2 ft. 5 in. high. The fixed top is only 14 in. wide, so that the table occupies little space when folded. It is, therefore, useful on porches, and in breakfast rooms, and other places where space is at a premium.

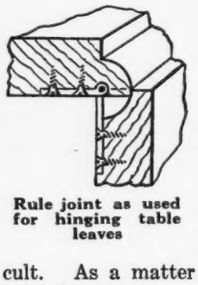
The table and gate legs are 1¾ by 1¾ in. by 2 ft. 4⅛ in., and the pivot legs, 1¾ by 1¾ by 16⅝ in. The top gate rails are ⅞ by 2½ by 12½ in.; the bottom gate rails, ⅞ by 2 by 12½ in.

The gates, which are pivoted on dowels, should be perfectly square and true to insure the outside legs resting squarely on the floor when the gates are open. Small blocks screwed underneath the leaves act as stops to prevent the gates being opened too far.

Two drawers 3½ in. deep, 9½ in. wide, and 16 in. long are fitted in the ends of the table. To give sufficient depth for them, the side rails are 5¼ in. wide; in length, the side rails are 2 ft. 6 in. Where each short gate leg is pivoted under the rail, a filler piece ⅞ by 1¾ by 5¼ in. is attached to the rail with screws from the inside.

Complete working details of this table, with alternative leg and top designs, are contained in Blueprint No. 24 of the Home Workshop series, together with a complete bill of materials. One of these convenient, time-saving prints can be obtained from the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, for 25 cents.

Many interesting variations are possible. The shape of the top can be made square, oblong, octagonal, or odd shaped, and the edge can be rounded or molded.



Rule joint as used for hinging table leaves

A rule joint table leaf hinge can be used in place of the simpler method of hinging the leaves that is shown. Amateur cabinet makers usually avoid the rule joint hinge because it looks difficult. As a matter of fact, the only trick in making it successfully is to lay out the joint so that the hinge pin is exactly at the point where the joint is to pivot. The pin represents the center from which the quarter round curves of the molded edges are swung, as shown in the accompanying illustration of a typical rule joint. In connection with this joint, use back-flap hinges with the knuckles let into the top.

The legs themselves can be turned, or if the maker is handy with carving chisels, a simple and more or less rugged ball claw ornament can be carved as feet for the otherwise plain legs. Inlays can be used for ornamenting the top, although they go best with a light and delicate style of table, such as the smaller variety of gateleg about 2 ft. 4 in. high. This small

(*Continued on page 95*)

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Cross-Cutting,
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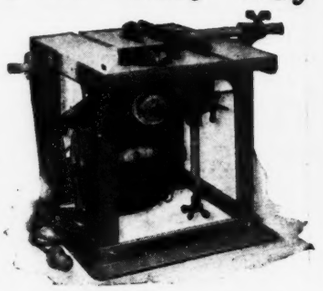
Grooving,
Grinding,
Sanding,
Drilling,
Dadoing.



Boice-Built Bench Saw Model 140 illustrated here and its attachments will do all of these things with ease, speed, precision and economy. Saws 7" dia. cut 2⅛" stock. Dado head 5" dia. cuts grooves 1¼" deep x ⅝" wide, maximum. Table elevates with screw adjustment. Motor ⅛ h.p. ball-bearing. Also cuts copper, brass, bakelite, tubing, rods, carbon, etc. Sold on Money-Back Guarantee.

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30x3½	7.40	12.55
32x3½	8.95	14.50
31x4	10.15	16.40
32x4	10.30	17.35
33x4	11.90	18.30
34x4	12.30	19.35
32x4½	12.55	20.10
33x4½	13.10	21.10
34x4½	13.40	21.90
35x4½	13.90	22.95
35x5	14.90	24.85
37x5	15.10	25.65

Send deposit of $1 for each tire ordered. Send only $2 if you order 2 tires. We ship C. O. D. for balance and allow examination. If not absolutely satisfied, return unused and we'll refund every cent of your deposit! You take no risk whatever! If you prefer to remit with order, deduct 5 per cent. **Money-Back Guarantee**

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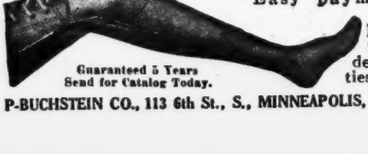

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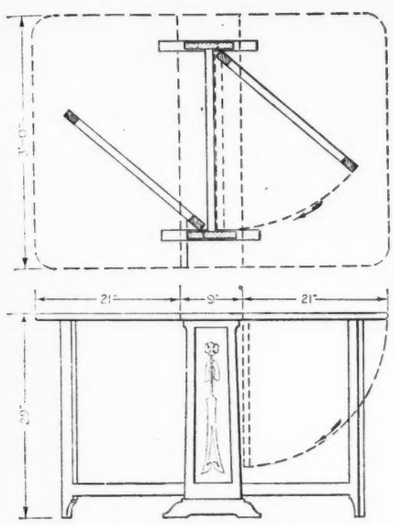
version of the gateleg often has a "piecrust" edge around the top.

Simpler than the standard type gateleg table is what is known as a "framed" gateleg. It is not so craftsmanlike or decorative, but is very easy to make.

The gates, as shown in the accompanying illustration, are merely two frames hinged to the ends. The frame connecting the ends is doweled securely to them and the fixed top is also doweled to the ends.

This table looks well in an enameled finish, as the flat surfaces of the ends offer a

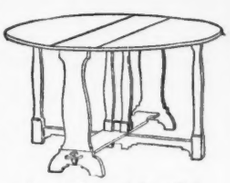


Typical "framed" gateleg table with painted ornament on the ends, made almost entirely of 7/8-in. stock

fine field for ornamentation. If made of hard wood, the ends can be treated effectively with simple strap or chip carving, inlays, or delicate moldings. It is also possible to enrich the ends with matched veneers of distinctive figure.

A variation of the same type of table is illustrated in the small sketch. Note the two fixed legs in the center of the table and the way the main bottom rail is fastened to the ends with a wedged mortise and tenon joint.

Gateleg tables of oak were often made in Colonial days, and later walnut and maple were used. Commercial tables in natural finish are usually walnut, mahogany, gum, or birch stained to imitate mahogany or walnut. The popularity of painted models in the softer woods, however, is increasing. Often such tables have rather large and gaily colored ornaments stenciled on the two leaves. Such decorations add interest to the table when the leaves are hanging down.



A gateleg with solid ends and two center supports

FEW radio receiving sets will have to be modified materially because of the new schedules assigning various wave lengths between 222 and 545 meters to broadcasting stations. Shortening the aerial and using a condenser in series with the primary of the tuner will bring in the lower wave lengths, and the addition of 75- or 50-turn honeycomb coils or other loading coils will increase the wave-length range.—R. T.

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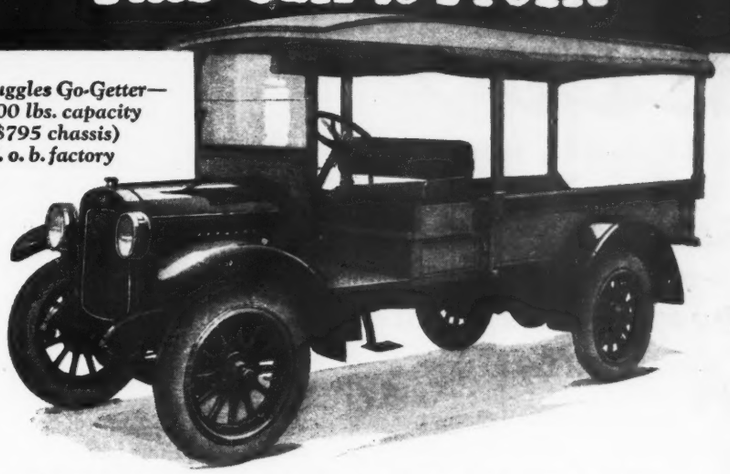

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THE HOME WORKSHOP

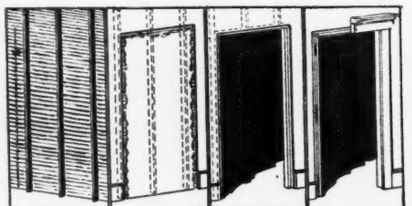
How to Cut a Doorway through an Old Partition

By A. E. Elling

THE home worker frequently hesitates to cut in an extra doorway, no matter how much one may be needed, because he is at a loss to know exactly how to proceed. It really is not difficult to put in a new doorway, and if a little care is taken, the work will equal that of a carpenter.

When the general position of the proposed opening has been chosen, tap the wall with a hammer to find out by the sound just where the studs are located. Studs are the upright pieces to which the laths are nailed, and they are usually 16 in. from center to center. If it is at all possible, one side should be marked out quite near a stud; the other side will, of course, have to be cut according to the width of the door, as at *A*.

Having plumbed down the first line, measure across 3 in. more than the width of the door, and measure up 3½ in. more than the height of the door, and draw lines carefully on the wall. For example, if the



Four steps in cutting, framing, and trimming a doorway in an old lath and plaster wall

door is to be 2 ft. 6 in. by 6 ft. 6 in., the opening should be 2 ft. 9 in. by 6 ft. 9½ in.

Cut the plaster to the lines with a chisel and hammer, breaking out only an inch or so. Then, with a coarse compass saw, cut through the laths, so that you can tear down both lath and plaster. Mark guide lines on the other side of the wall exactly opposite and cut out in the same manner.

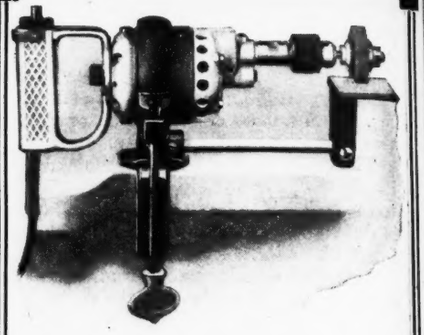
I prefer a narrow compass saw for cutting the lath to a handsaw, as it does not bind so much. Some cut through the plaster as well as the lath with a saw, but I don't consider it good practice, as the edge is at once taken off the saw. In fact, it is much harder work and no quicker. It takes only a few minutes to chip out the plaster sufficiently to expose the lath, as shown at *B*.

It is comparatively easy to cut near the stud, but on the other side, where the laths may project as much as 7 in., care must be taken or the edge will be jagged. One way to prevent this is to attach a board about 7 ft. long close to the line with fine nails and cut down close to the edge of the board, so that the plaster will not be broken out where it might show.

The next step is to cut out the studs with a handsaw. Then cut a piece of 2 by 4 in. and push it up in place to form the head. Cut two studs the right height for one side and one for the other, as indicated at *C*. The opening now should measure 2 ft. 9 by 6 ft. 7½ in. Nail the head and sides squarely and tack to the studs any loose laths along the sides.

The opening is now ready to receive the jambs. Set the jambs plumb with great care, as otherwise the door may develop an annoying habit of closing by itself. See

(*Continued on page 97*)



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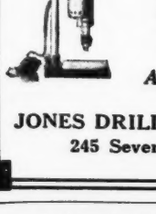

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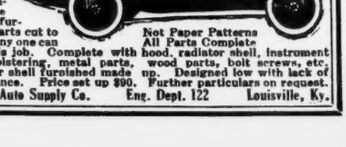


Not Paper Patterns All Parts Complete

The Central Auto Supply Co. Eng. Dept. 122 Louisville, Ky.

THE HOME WORKSHOP

How to Cut a Doorway

(*Continued from page 96*)

that the head is level or the job will look badly. The extra space allowed between the jambs and studs is to allow blocking to be used in plumbing the frame, as well as space for the hinges and lock blocks, which should always be inserted opposite hinges and lock, as at *D*.

If the base pieces adjacent to the doorway are short, it is easiest to remove them and fit them back again after the casing is on. Otherwise, mark exactly where the casing comes on the face of the base, drive it out from the wall, putting a block behind it to hold it out, and cut down on the line with the point of the saw.

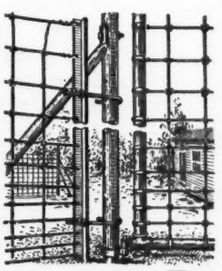
Generally speaking, it is cheapest, if a woodworking mill is near by, to buy the jambs, door stops, saddle, and trim complete to suit the size of the door. Sometimes old-fashioned trim has to be matched, in which event it must be made by hand, and then the home worker can profitably do the work himself. Remember always that it is not necessary to make moldings and trim in one piece. Several odd pieces of molding will often work together to make a fair match for old-fashioned trim.

Rubber Cement Aids in Tracing

TO PREVENT tracing paper from slipping when small tracings are being made, spread some rubber cement around the drawing or print and press the tracing paper firmly over it. When the cement has set for a moment, the paper will be fixed firmly in place. After the tracing is finished remove it and rub the cement off gently with the dry fingertips.—L. B. ROBBINS.

Wire Fence Rolls Up when Chicken Run Is Plowed

TO PERMIT a long and narrow poultry run to be plowed and harrowed, some provision should be made for opening both ends of the run. Usually there is a wire gate at one end, but it costs too much to place a gate at the other end. An inexpensive substitute for the second gate, which has been adopted by the Poultry Department of MacDonald College, Canada, is a removable end section.



The end fencing can be unhooked from one corner post

The wire is attached permanently to one outside end post and is then run across the ends of all the runs and attached temporarily to the various posts. The other end is fastened to a piece of angle iron, the length of which is equal to the height of the fencing. A number of holes are bored in one L of the angle iron for fastening the strands of wire to it, and two holes are drilled on the other L, one near the top and the other near the bottom, for hook bolts that grip the fence post. Nuts on these bolts permit tightening the fencing.

When plowing is necessary the end fence is rolled up and stands on end near the corner post to which it is permanently fastened.—W. A. MAW, Quebec, Can.

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Put "Hanes" in comparison for generous full size; for reinforced strain-points; for extra-strength-elastic webbing; for buttons sewed to stay on; for buttonholes that last the life of the garment! Compare "Hanes," we tell you, and know what you buy for $1.00!

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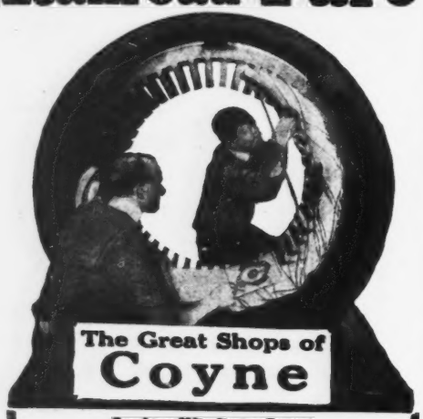

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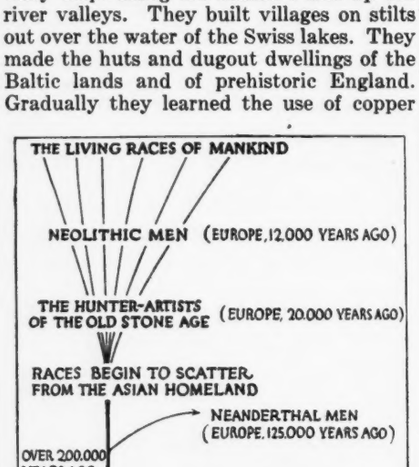
How Science Traces Our Monkey Ancestry

(*Continued from page 31*)

other kinds of grain. These were the people whom scientists call Neolithic, the men of the New Stone Age, distinguishing them thus from the more ancient inhabitants, Neanderthals and Cro-Magnons and the rest, who are grouped together as the Paleolithics, or men of the Old Stone Age.

Slowly, century by century, these newer Neolithic men spread over Europe, absorbing or exterminating the Cro-Magnon hunter-artists who had preceded them. They crept along the seashore and up the river valleys. They built villages on stilts out over the water of the Swiss lakes. They made the huts and dugout dwellings of the Baltic lands and of prehistoric England. Gradually they learned the use of copper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NEOLITHIC MEN (EUROPE, 12,000 YEARS AGO)
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ABOUT 20,000,000 YEARS AGO
THE LIVING MONKEYS OF AFRICA AND INDIA
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THE LIVING LEMURS OF MADAGASCAR
THE MAIN STEM OF EVOLUTION IN ASIA
THE ANCIENT ASIAN LEMURS OF 60,000,000 YEARS AGO

Chart of the origin of man

and then of bronze. One group of them developed the city-states of ancient Babylonia. Others began what was to be the great empire of Egypt.

The world today is peopled by descendants of these Neolithics. From about 20,000 to about 10,000 years ago, wave after wave of them rolled out from Central Asia over the world. There were many races among them; the same races that still exist. Some went east and became the Mongolians, the Eskimos and the American Indians. Some went south and developed into the negroid peoples. Others went west and northwest and became the whites.

And now let us trace in review the discernible stages in the more recent ancestry of man. First are the little arctic lemurs and then the Central Asian monkeys. Next come the ground apes whose bones we have found in the North Indian hills. After them were the apelike men repre-

(*Continued on page 99*)

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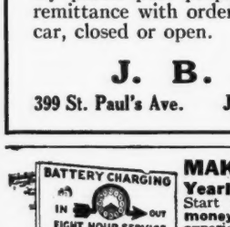

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How Science Traces Our Monkey Ancestry

(*Continued from page 98*)

sented by Pithecanthropus and then the early men of Piltdown and of Heidelberg. Next are the cavemen of Neanderthal, the first real conquerers of Europe. And finally we have the modern man—the Cro-Magnons of the Old Stone Age, the Neolithic agriculturists, the various races of today.

And this bodily history is man's mental history also. The monkey has already the beginnings of a human brain. The mind of man is his greatest possession, his sole and sufficient instrument for the conquest of the world. And this, too, has grown from small beginnings in lemur and monkey and ape. The modern students of psychology, of inhibitions, inversions, and unconscious fears, are beginning to learn what the evolutionist knows—man's mind is built upon a basis of the monkey mind, no matter how far from the starting point it has since progressed.

¶ Next month—Man's Conquest of the World—another amazing story in this fascinating romance.

¶ The dawn of human intelligence; man's irresistible advance; his discovery of science; his primitive ingenuity; his first agriculture, arts, and manufacturing—all this in another absorbing chapter of Doctor Free's absorbing and simply told story.

¶ It is a story you can't afford to miss. Ask your newsdealer today to save your July POPULAR SCIENCE MONTHLY.

FOR FURTHER READING

THE best book on the subject of this article is "Men of the Old Stone Age," by Henry Fairfield Osborn (Charles Scribner's Sons, New York, 1921). Scientific details of the views here presented regarding the animal ancestry of man will be found in "The Origin and Evolution of Human Dentition," by William K. Gregory (Williams and Wilkins, Baltimore, 1922). On Neolithic men see "The New Stone Age in Northern Europe," by John M. Tyler (Charles Scribner's Sons, New York, 1921).

Fear—Man's Greatest Bogie

(*Continued from page 24*)

as "passed away" or "gone to a better world." During the war the soldiers said that a "buddy" who had been killed had "gone west" or was "over there."

Then there is the dread of inclosed places—claustrophobia, as it is technically called. This fear is what makes it difficult for some persons to sleep in the lower berth of a Pullman car, though they sleep without difficulty in the upper. These same people avoid narrow streets lined by tall buildings and are afraid of closed telephone booths.

Closely related is the fear known as agoraphobia, the Greek term for "fear of the market place"—dread of open spaces.

I remember seeing in a dispensary a patient who could not cross Union Square in New York without being so uncomfortable he would be almost overcome. He had to walk around the square, close to the buildings. Curiously enough, if he were accompanied even by a little child, that was sufficient to allay his fears.

Some persons are afraid of pointed objects. They cannot even endure pointed scissors in the house. Pointed knives, awls or files strike them with terror. They find it hard to explain their fear, though it is associated with the dread that they may do some harm to themselves or to others.

Animals are often the innocent cause of human dreads. The typical instance is

(*Turn to page 100*)

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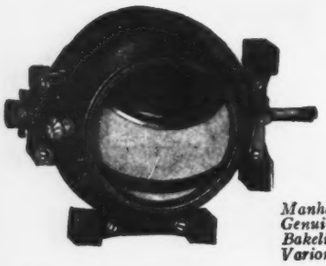

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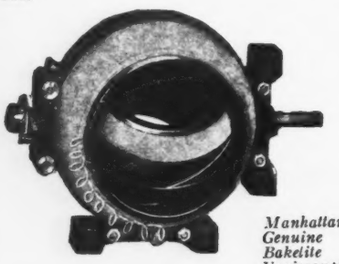

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Fear—Man's Greatest Bogie

(*Continued from page 99*)

woman's dread of mice. There is the well-known story of the woman lion tamer who screamed and fled to the safety of a chair at the sight of a mouse.

On the other hand, there are women for whom animals hold no terror, yet who are frightened by human beings. Consider the recent experience of Miss Martha Miller, of the American Museum of Natural History. Returning from an exploring trip to the Belgian Congo, where she had shot lions and elephants, she went to Newark, N. J., to address an audience. At sight of the crowd, this otherwise fearless young woman, who thought nothing of facing a ferocious lion, fainted dead away!

Some people are very much afraid of cats—so much so that even the presence of a cat in the room makes them extremely uncomfortable. A cat entering their sleeping quarters at night will awaken them.

Curiously enough, some who are afraid of domestic cats have no special dread of the big cats—the lions and tigers in menageries. Dread of dogs also is strong in some people. A dog turned loose in a room will disturb them deeply.

The more we know of dreads, the more we realize that the state of mind known as scrupulosity, or the dread of sin, should really be classed among fears such as dread of dirt and of falling from a height, rather than with any special spiritual state. Sometimes it is assumed that such scrupulous persons are better than others; as a matter of fact, they are only more nervous. Their condition is a real nervous affection and can only be treated successfully like the other dreads.

Fear Can Be Conquered

Just as the dread of heights is a typical example of the fears of mankind, so its conquest demonstrates best how to overcome such fears. Reasoning with fears is useless. They must be overcome by forming habits, patient y and persistently, to counteract them.

Nearly all men who work on high buildings have some dread of heights. Many of them suffer severely from it. Yet they learn to overcome it by practising self repression and control—will power.

I knew a man with a really pitiable fear of the dark who had to take a job as night watchman in a lonely factory far out from town. He lost more than 30 pounds in weight before he gradually overcame his dread. But he did it. Another man with an awful dread of microbes became an expert bacteriologist, though not without a protracted effort at self conquest.

Practically any one can overcome a dread in just this way, provided he really wants to. If he is compelled to do it in order to support his family, then it becomes comparatively easy of accomplishment. But in any case, nerve to push through to successful self control is necessary.

For those who lack sufficient will power to overcome their dreads science soon may discover a cure. An expedition of scientists has just returned from South America with a new drug, caapi, which they believe will effect such a cure.

If their claims are substantiated, the new drug will be one of the most important discoveries in pharmaceutical history.

(Doctor Walsh is preparing an article on will power, probably the best cure for fear, for an early issue of POPULAR SCIENCE MONTHLY.

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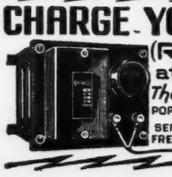

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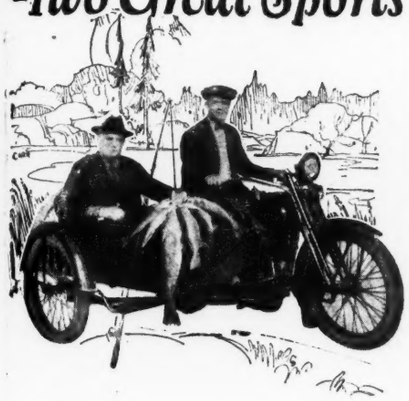

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Scientific Baseball

(*Continued from page 41*)

two bases in about 3½ seconds. If this is shorter than the time it takes for a batted ball to travel to a player in the field, plus the time it takes the player to field it and throw it, plus the time elapsed in the flight of the ball from the fielder to the baseman, the runner is safe. That is why a slow grounder is safer than a fast one. That also is why the player who becomes "one step slow" can't stay in the big leagues.

Baseball is a game of split seconds. Some of the most important plays are figured out with an infinitesimal fraction of a second as the margin of safety. One of the plays figured out on a split-second basis is the famous "squeeze" play, designed to bring a runner home from third base. When this play is to be attempted, the manager signals to the runner and batter. The runner has orders to lead off from third and start at full speed for the home plate with the first motion of the pitcher. The batter lays down a bunt along the right foul line. As he starts for first base, the runner from third is well on his way home. By the time the bunt can be fielded and thrown home by the pitcher or first baseman, the runner has slid across the plate. If the play succeeds, it is by the narrowest of margins.

Making a "Hit and Run" Play

Another bit of split-second baseball strategy is the "hit and run" play. With a runner on first base, the manager signals to him and to the batter at the plate that the next ball pitched must be hit. The runner starts with the first motion of the pitcher, in an attempt to reach third base. The batter must hit the ball to right field, so it will go behind the runner, and thus increase the distance of the throw to third base. When this play succeeds, it is by a very small margin.

The batting rally I cited at the outset is a striking example of hit and run tactics. Every Giant player knew that the next man up would hit the first ball pitched, and acted accordingly.

The chances of a runner in moving from one base to another also are figured out mathematically. Since a ball can be thrown across the diamond in any direction in about one second, the runner must gain every possible advantage in the way of a long lead and a quick start. Third base is easier to steal than second. Because the second baseman and the shortstop must play a considerable distance from second, the runner on second base can take a longer lead.

Famous Players Who Stole Home

It is almost impossible to steal home; but it has been done. In the World Series of 1921 McNally and Meusel of the Yankees both stole home. The only other man who ever performed this spectacular feat in a World Series was Ty Cobb, the greatest of all baserunners, who put it over in the Detroit-Pittsburgh series of 1909.

Walter Johnson's fast ball, Christy Mathewson's baffling curves, and Babe Ruth's home runs, all come under the general head of physics in scientific baseball. The speed of a pitched ball naturally depends on the force behind it. The curve depends on the direction in which the pitcher spins it, and the distance of a hit is determined by the driving force applied by

(*Turn to page 102*)

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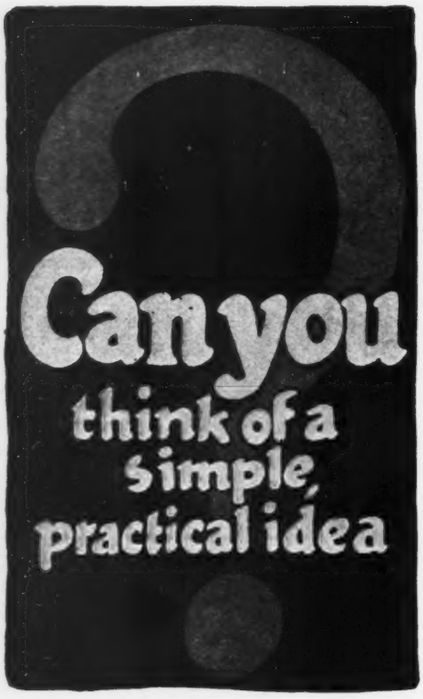

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American Industries, Inc.
515 Kresge Bldg., Washington, D. C.

Scientific Baseball

(*Continued from page 101*)

the batter, plus the force of the pitched ball as the bat crashes into it.

The direction and elevation of the hit are determined by the angle at which the bat meets the ball. These natural laws the greatest hitters have closely studied. The result is that every big league team boasts of one or more accurate "place" hitters who can be depended to hit the ball to right field or left, as the occasion demands. The late Willie Keeler was the pioneer place hitter of baseball. When asked how he managed to hit safely so often, his characteristic reply was: "I hit 'em where they ain't."

Speaker's Marvelous Sense of Distance

Tris Speaker understands the physics of baseball about as well as any man in the game. When a fly ball is hit to center field, he can tell at a glance exactly where it is going to land. He never overruns or underruns a fly. His remarkable ability prevented Brooklyn from tying Cleveland in the eighth inning of the first game of the 1920 World Series in Brooklyn. Krueger, the first man up, hit a long fly toward the center field fence that looked good for a three bagger. Speaker turned tail and ran nearly to the fence. There he whirled about at exactly the right spot and caught the fly, without having slackened his speed by looking back.

Ray Schalk is another great player who seems to have an uncanny judgment of flies. He never goes after an impossible foul fly behind the bat, but I have seen him catch some that looked impossible. Whenever he goes after one, it is his.

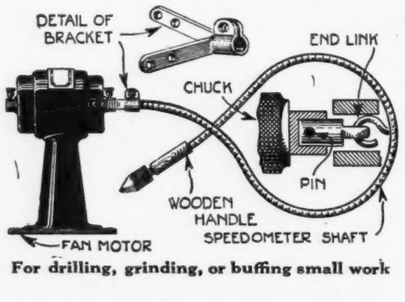
Science on the diamond is an asset that players and managers and team owners are constantly studying and using to increase the popularity of baseball. Despite the columns written by baseball writers about the danger of too many home runs, the fact remains that the public likes powerful, scientific hitting and plenty of it.

Babe Ruth alone can fill a grandstand. I think that proves my point.

Speedometer Shaft and Motor Form Flexible Bench Tool

A FIXTURE that can be put to numerous uses about the bench such as drilling, grinding, and buffing, can be made from a speedometer shaft and a small electric fan motor.

Fix the linked shaft to the end of the fan shaft and secure the shaft housing to the frame or motor housing. In the opposite



For drilling, grinding, or buffing small work

end of the speedometer shaft any small chuck similar to a hand-drill chuck is fastened. A hollow cylindrical wooden handle about 1½ in. in diameter is provided by taping it on the end of the shaft housing or binding it with twine.—G. A.

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THE HOME WORKSHOP

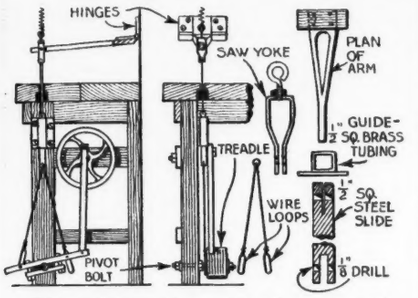
How to Build a Heavy Duty Bench Fretsaw

By Joe V. Romig

ONE of the handiest tools for the home workshop is a heavy duty bench fretsaw. It will do a large variety of useful work in both wood and the softer metals, and saw blades can be bought in numerous lengths and widths.

The saw illustrated costs little to build. When the blade is disconnected, it can be dismantled and the frame folded back against the wall so as to leave the top of the bench clear for other work.

The double action treadle is coupled to a flywheel by means of a wooden connecting



Side and front views of the fretsaw and details of the arm, yoke, slide, and guide

rod. A wheel that will serve for the flywheel usually can be found in the junkyard.

The saw arm is wood, shaped as shown, and is hinged to the wall at the back of the bench with two hinges. A saw yoke made of thin sheet metal is fastened to the outer end and is tapped for a screweye, to which is fastened the end of the spring.

The slide and guide are simply a square length of steel running up and down in a square brass tube soldered to a flat brass plate. The slide piece is slotted at each end and drilled, as shown, for the pins that hold the saw blade and treadle wire.

Each end of the treadle wire has an elongated loop that slides on round headed screws in the edge of the treadle. The throw of the crankpin on the flywheel should be about 6 in. and the total travel of the treadle at the points where the wire is connected with it should be about 3 in. As the saw blade is always pulled upward by the spring, the mechanism comes to rest with the treadle in a horizontal position and therefore can be started with a light pressure of the foot.

A Screw that Cannot Be Easily Taken Out

AFTER a petty thief had taken out the screws of my toolbox and helped himself to my tools, I devised the method illustrated of filing the heads of the screws so that they can be removed only with special effort.

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What Do You Know about Science?

Following are correct answers to the questions on page 46

The Human Machine

1. We get tired because the muscle fibers get changed somehow so that they can no longer contract so strongly. Science does not know for sure whether this is because some necessary food material in the muscle fibers is used up or whether it is because the use of the fibers produces some poisonous chemical in them that has to be taken away and dispelled by the blood.
2. Men of the white race have from 40,000 to 60,000 hairs in a full head of hair. Women may have as many as 70,000.
3. The color of the hair is due to thousands of little granules of colored substances put inside the growing hair by the hair cells in the scalp. When your hair turns gray, it means that these cells no longer make this substance. They are badly nourished.
4. There are 206 bones in the body, including the three little bones in each ear.
5. Any injury to the body sets blood flowing to the injured part in order to repair the damage. Some of this blood, or some fluid from it, usually leaks out of the blood vessels and seeps in among the fibers of the muscles and the other tissues. This makes the tissues swell and forms a bump.
6. Too little blood in the brain causes fainting. Suppose you are lying down and get up quickly. Most of the blood in your body suddenly drains down out of your head. The brain is deprived of blood, it runs out of oxygen and you faint.
7. Sneezing is an automatic device to keep insects and other dangerous things from getting into the lungs and the air passages leading to them. If anything touches the nerves in the lining of the nose, they send a message to the nerve center in the brain which controls the muscles of the chest. This center orders a sudden contraction of these muscles and the resulting sneeze blows out whatever touched the nerves.
8. In the United States the average for boys is seven pounds 10 ounces; for girls it is seven pounds 2½ ounces.
9. Consumption or tuberculosis. Heart disease sometimes ranks ahead of tuberculosis in the statistics, but heart failure is a general name for a great many diseases.
10. Colds are due to germs that grow in the tissues of the nose and throat so that these tissues get inflamed and swell up. These germs are always lurking about on the moist surfaces of the mouth and nose but when we are in good health they cannot get a foothold in the tissues. A severe fatigue, a spell of indigestion, a great chilling of the body or some other thing that lowers our vitality temporarily, may give the germ a chance to enter the tissues and get a start. Then we have a cold.

What Things Are Made Of

1. The difference between atoms and molecules can be made clear by an example. Water is made up of two parts of hydrogen and one part of oxygen. The smallest possible particle of water still has this composition. It is a water *molecule*. It consists of two *atoms* of hydrogen and one *atom* of oxygen held together in a chemical combination. If you split this up, it is not a *molecule* any more. Neither is it water. It is merely some loose *atoms* of the single elements hydrogen and oxygen.
2. Iron is a chemical element—a substance that cannot be split up into other substances except by disintegration of its atoms.
3. Radium also is a chemical element; one of the metals. Its extraordinary importance in science is due to the fact that its atoms are explosive. A few billion of them explode every second, even in a very small piece of radium. And when one of them explodes, it breaks into an atom of the gas helium, which is thrown out with great force, and an atom of another radioactive element called "niton."
4. The smallest distance actually measured so far is the distance between the atoms in a crystal of common salt. It is about 100 millionths of an inch. If a cube of salt an inch square were enlarged until it reached from New York to Chicago, the atoms in it would be a little over half an inch apart.
5. The metal osmium, which is a rare metal much like platinum. It weighs 22½ times as much as an equal volume of water.
6. Lithium, which occurs as a chemical compound in lithia water. In the form of metal it is merely a chemical curiosity. Its specific gravity is about half that of water.
7. Because pure gold is too soft. Its molecules do not stick together very tightly and too many of them would rub off and get lost when the coin was carried about and used. So a little copper is put into the gold. This makes the molecules of gold stick together more tightly so that the coin is harder.
8. Coal is an impure form of the chemical element carbon. When it burns, the carbon combines with the oxygen of the air. The impurities in the coal are left behind as ash.
9. Smoke is mostly little particles of carbon that were not burned in the fire. If a fire burns very fast, and especially if the fuel is soft and easily broken up, like wood or soft coal, a lot of tiny carbon particles are torn off and carried up the chimney before they have time to catch fire and burn.
10. Alcohol is made by yeast, which is really a tiny living plant. A cake of compressed yeast contains billions of them. These plants convert sugar into alcohol.

How Things Work

1. When you throw the ball down, the force with which it hits the pavement flattens one side of the ball. The rubber (or the compressed air inside) resists this flattening. This push makes the ball rebound.
2. This is an instance of inertia. The standing people are moving with the car. They tend to keep on moving when it stops. The law of inertia is that matter at rest tends to remain at rest and matter in motion tends to remain in motion until some opposite force is applied to it.
3. The friction of the air. The pitcher gives the ball a spin. This spin causes more air friction on one side of the ball than on the other side and makes the ball curve.
4. Flies have little suckers on their feet by which they can stick to things.
5. Woolen clothes are warmer than cotton ones because they hold more air and hold it tighter. Air, when it cannot move, is a very poor conductor of heat. The layer of air entangled in the meshes of clothes prevents the body heat from escaping
6. The ice cools the air around it. This makes the air heavier and the cooled air sinks. Warm air comes up from the lower part of the refrigerator. There is thus a continual circulation of the air.
7. Pressure increases heat. Heat also increases pressure. If a tire gets hot, the air pressure inside it goes up. If the pressure rises too high or if the tire is weak anywhere, it may blow out.
8. Light travels about a million times faster than sound does. The light is practically instantaneous. The sound takes about five seconds for every mile.
9. The smooth walls of the inside of the shell cause a great many small echoes. When you hold the shell to your ear, some sounds from the street or the room get into it through the crack between it and your ear. These echo around inside and rumble like the waves.
10. Most solids swell a little when they are heated. Glassware does. A cold glass put into hot water swells; some parts more than others. This makes strains in the glass and breaks it.

THE HOME WORKSHOP

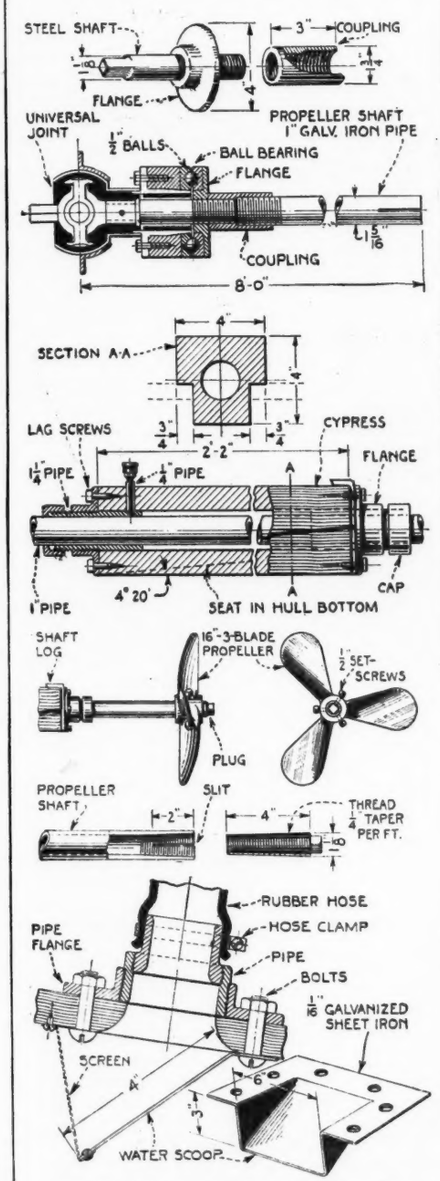
Cheap Motor Drives Sport Boat

(*Continued from page 75*)

hull because the bend is well above the water line.

The transverse ribs are 1-in. stock. White cedar can be used, as well as oak or other hard woods. The engine bearers are oak 1 in. thick, with steel plates to take the engine brackets.

Every step in building the hull should be governed by the thought that the high speed developed by the hydrosled imposes



Details of the propeller shaft and bearing, the method of mounting the propeller, and the construction of the water scoop

a strain that will quickly reveal any weak places. For this reason, each plank and beam should be fastened liberally with copper or galvanized nails, screws, or rivets.

The shaft log or propeller shaft bearing must be fastened rigidly to the stern planking and bored in fairly accurate alinement with the engine. The weaving of the hull is accommodated to a considerable extent by the flexibility of the universal joint, which is retained for that purpose.

The propeller should be of a high speed

(*Turn to page 106*)

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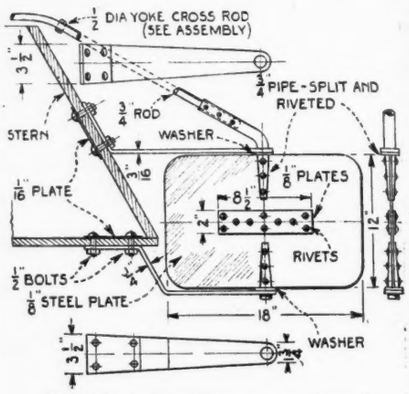
THE HOME WORKSHOP

Cheap Motor Drives Sport Boat

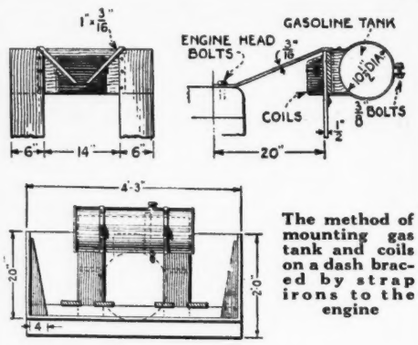
(*Continued from page 105*)

type, preferably three-bladed, about 14 or 16 in. in diameter, with a 22-in. pitch. An 18-in. propeller will obviously give a higher speed, but the additional load on the engine will make necessary more frequent adjustments in the bearings to overcome the wear.



How the twin rudders are made and mounted

With the position of the engine and propeller as shown, a speed of about 25 miles an hour can be obtained under favorable circumstances. To increase this speed it would seem necessary only to lower the position of the propeller, but as that would involve tilting the engine, it is not advisable because the oiling would become difficult and uncertain.



The method of mounting gas tank and coils on a dash braced by strap irons to the engine

Success in constructing a boat such as this depends much upon the ingenuity of the builder, and all sorts of modifications are possible. While all important dimensions are given in the drawings, there is nothing hard and fast about them and they can be varied within limits to suit the ideas of the builder.

(Valuable pointers on building hulls will be found in the series of articles by Captain McCann, "New Motorboats from Old," the second of which appears this month, and in a description of a homemade sailing lark, by Mr. Stillman Taylor, on page 105 of the April issue.)

—THE EDITOR.

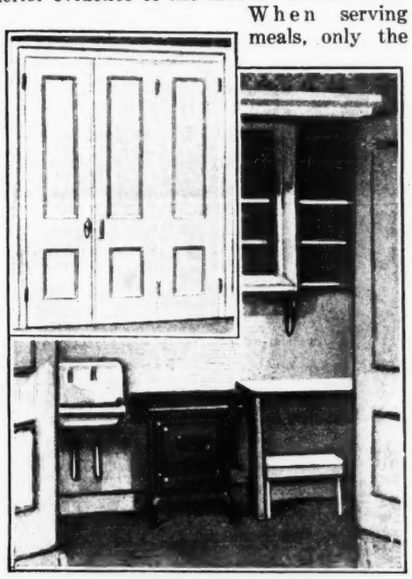
MANY troubles experienced by beginners can be traced directly to faulty construction or defective parts. Be careful that you thoroughly understand a wiring diagram before connecting a set. If your set does not work, it is sometimes advisable to tear out all wiring and do the job over again, using ordinary bell wire, which can be replaced with heavier wire when the hook-up has proved satisfactory.—J. C.

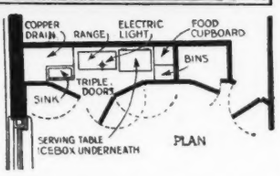
THE HOME WORKSHOP

Kitchenette Closeted in Dining Room Saves Housewife's Steps

WHEN space is limited, a kitchenette can often be closeted at one side of the dining room, as illustrated. This is primarily an apartment house idea, but it is applicable to remodeling work, to two and three story flats, to small cottages, and to large old-fashioned houses where the kitchen requires too much time and effort to maintain.

An area 2 by 8 ft. is all this closeted equipment requires. Three doors are opened during the preparation of meals, and after the dishes have been cleared away, these doors are closed and all exterior evidence of the kitchen is concealed. When serving meals, only the center door need be partly open for access to dishes that have to be kept hot on the range.





The kitchenette open and closed and a plan showing the space saving layout

The kitchen is complete in all essentials. On the left side is the sink, and extending from this to the side and rear is a copper drain of large size. In the center is the range with glass partitioned cabinet above. To the right of this is the serving table or board, under which is a space for a small refrigerator, not shown in the illustration. Access to the icebox is obtained by lifting up the serving board, which is hinged at the rear and can be fastened in the raised position by a hook on the edge.

On the extreme right and behind the door frame are food containers, a cupboard, and two sliding bins for flour and meal. A strip about 4 ft. up extends around the inside and is fitted with hooks several inches apart for various kitchen utensils. At the center is an electric light.

The shelving shown at the sides of the glass cabinet extends all the way up to the ceiling, and ample space is provided for canned foods, packages, pans, and china. Above the range and connecting with the chimney is a ventilator to keep the odors of cooking out of the dining room.

Apart from its economy in space, this small kitchen saves countless steps and reduces housework to a minimum.—G. A.

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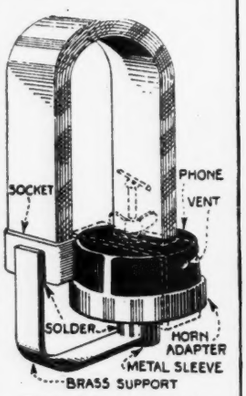
THE HOME WORKSHOP

How I Improved My Homemade Loudspeaker for a Dollar

By John A. Mahon

I HAVE improved my homemade loudspeaker so that it compares favorably in volume, sweetness of tone, and absence of distortion with any of the high priced commercial loudspeakers on the market. Like many radio fans, I have been using a Baldwin C phone, modified by a simple adjustment such as I described in an article on page 107 of the March issue of POPULAR SCIENCE MONTHLY. To carry the improvement still further, I added a permanent magnet, as shown. It is a magnet of the type used in auto magnetos.



Powerful permanent magnet added to Baldwin phone

A slot is cut with a hot knife in the top of the telephone to take one leg of the magnet, so that the magnet will fit loosely over the armature in the phone. The other leg is held in a socket made of tin or brass, and supported by a brass rod attached to the brass sleeve of an ordinary phonograph horn adapter.

In placing the magnet in position for use, tune in some station that is relatively weak. Then try out each side of the magnet to see which gives the louder tone. When this has been determined, place the other leg of the magnet in the socket. See that the magnet makes good contact by scraping off the purple varnish on top of the phone armature. That is all that is necessary. You will find the stations coming in much better than before.

With 100 volts on my amplifier plate circuit, I have brought in New York stations so loud that they could be heard for blocks away, and on local stations I use a detector tube alone, as otherwise the broadcasting would be unbearably loud.

The vent hole and the wingnut clamping attachment, shown in dotted lines in the illustration, is the adjusting device described in the article mentioned above; both improvements together give me a loudspeaker different from any on the market and one that has proved most satisfactory in regard to both volume and clearness.

Radio Wave Trap Helps to Cut Down Interference

VERY often the use of a "wave trap" will aid you in reducing interference from conflicting broadcasting stations. Such a device can easily be made by connecting a variometer in the ground circuit in series with the tuning coil and connecting a variable condenser of about .001 mfd. in parallel with the variometer.

The set is first adjusted to receive the desired station as clearly as possible and by further adjustment of the variometer and variable condenser, the undesired station can be tuned out. This is particularly useful when two broadcasting stations are located so that their signals come in with about the same strength.—S. L. G.

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How to Paint Furniture

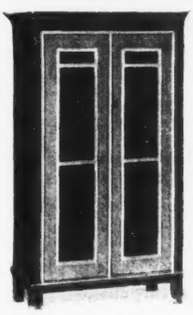
(*Continued from page 76*)

if necessary, it can be colored as heretofore described.

For the enamel itself, the brush must be absolutely clean and free from dust. Although the enamel will flow on and level itself, it is important to brush it first with, then across, and finally with, the grain in order to spread a perfectly even film. If this is not done, the enamel will either refuse to dry thoroughly on the horizontal surfaces, or will run in a discouraging fashion on vertical or inclined surfaces.

All coats of enamel but the last can be thinned with turpentine. Each coat is sandpapered and dusted after it is hard. The last coat is applied as it comes from the can.

The question of how many coats to apply depends entirely upon the kind of work and how good a finish is desired. For average work, from one to three coats of enamel are used. At least three should be used if a rubbed finish is desired, such as for good bedroom pieces. It is important to make sure, in that case, that the last coat is a grade of enamel intended for rubbing. When dry, this coat should be rubbed either with No. O steel wool used dry, which is the most convenient method for the home worker, or with powdered pumice stone on a wad of soft cloth, an old piece of felt, or a regular rubbing felt. The cloth or felt is moistened with water, and the pumice stone is sprinkled on it. Plenty of water must be used, and all the surfaces must be rubbed uniformly. Do not rub too long or too hard. Six or eight passes of the rubbing felt are ordinarily enough. Small, irregular surfaces and moldings can be rubbed with pumice stone on cotton waste.



Simple stripes and panels of color make even the plainest piece of furniture attractive

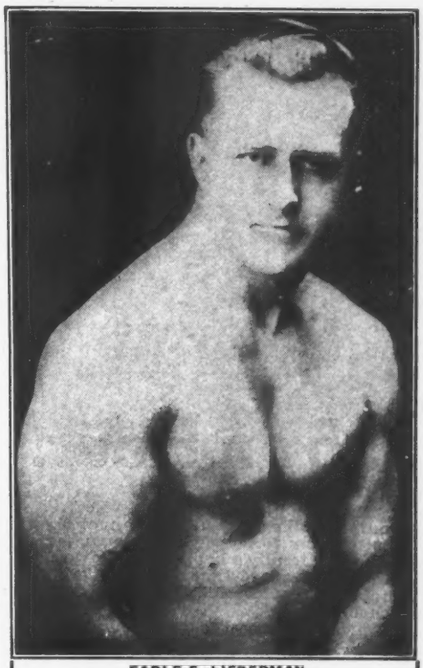
If you wish to polish the surface, give it a further rubbing with rotten stone and oil, either a regular polishing oil or machine oil or white mineral oil. An imitation rubbed finish can be obtained without the labor of rubbing by using specially prepared enamels that dry flat or with an eggshell gloss.

To make a good job of enameling an old varnished piece of furniture, it is advisable to remove the varnish entirely. Failure to do this is one reason why refinished furniture sometimes chips and cracks.

When surfaces have been finished in other ways than varnishing, it is sufficient to wash them thoroughly so as to remove all grease and dirt, and then sandpaper until smooth and free from all traces of gloss. One or more undercoatings are then applied, as the condition of the furniture seems to require, and the finishing is done as previously described.

Wicker furniture should be cleaned as thoroughly as possible before attempting to paint it. The ideal way to finish it is to spray on the paint or enamel, which is a simple matter if a power or foot pump sprayer can be obtained. The spray drives the color into all the depressions without

(*Turn to page 110*)



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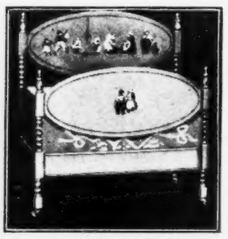
How to Paint Furniture

(*Continued from page 109*)

the danger of runs that is always present when a brush is used. A good job can be done with a brush, however, if the enamel is thinned with turpentine and put on as dry as possible with an oval bristle brush. The brush should be applied with a rotary pressing movement to work the color in well.

Often chairs enameled at home have a tendency to remain sticky. This can be avoided by thinning with turpentine each coat that is used for such surfaces as chair seats and table tops, and allowing it to become thoroughly hard before the next coat is applied.

Enamels flow best at a temperature of about 70 degrees, and when drying require a certain amount of air, so that the room should not be shut up tightly. Leave either the windows or the doors open a little. Daylight is another requisite, and the window shades, therefore, should be left up.



A child's painted bed with "transfer" ornaments

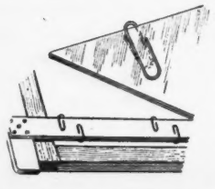
The brushes should be treated with the utmost care, and kept between coats, or when not in use, with the bristles suspended in turpentine. After using, they should be cleaned with turpentine. The enamel cans should always be tightly closed.

Your best efforts in enameling are apt to be spoiled if the surfaces are afterward washed with gasoline, turpentine, ammonia, or other strong cleanser, or even rubbed with many varieties of furniture polish. One leading manufacturer of enamels recommends that cleansing be done with the suds of neutral soap and soft, warm water applied with a sponge, to only a small surface at a time. The sponge is then squeezed dry and the suds wiped off with it. The surface is dried with a chamois skin.

Sometimes it is not necessary to enamel an entire piece in order to give it charm and distinction. Bands or stripes of colors can be applied on pieces that are varnished or polished. Some of the leading furniture manufacturers are using this trick to give a touch of color to otherwise dark furniture. For instance, with a walnut bedroom set, rich gray-green stripes and bandings are often most attractive.

Paper Clips Prevent Blots

WAITING for the ink to dry on a tracing wastes considerable time. If a draftsman hurries, however, he is apt to blot one or more lines already drawn. To lessen the likelihood of blots, fasten several paper clips on the edges of the T-square, triangles, and irregular curve. These clips will raise the instruments enough to keep them from coming in contact with the tracing cloth.—A. L.



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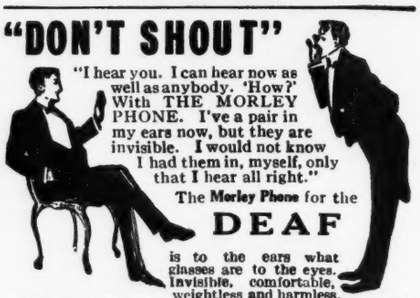

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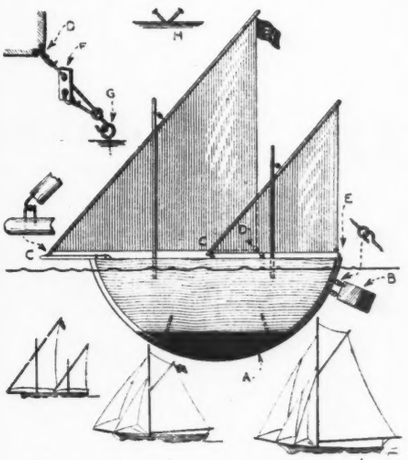
Barrel Head "Flyer" Is Speediest Model Yacht

THE fastest and simplest model yacht that can be built, is one that has half a head of a cask or barrel for a hull. This does not make a beautiful hull, but it will beat most of the more elaborately built or hollowed-out models of conventional and expensive types.

Half or nearly half the head of a fair sized cask is needed. You will find one edge beveled more than the other, so cut the lesser bevel until both are alike. Then cut the cask head on a line parallel with the deck and about one quarter up from the bottom, as shown, and replace the piece with plug lead, sheet lead, or old pipe, hammered into shape as at *A*.

Put the hull into water at least 2 ft. deep and see how it floats. It must be quite upright, with about 1 in. out of water, the deck being parallel with the waterline, or a trifle high astern. The rudder, to be fixed later on, will lower the stern a trifle. Shave



Cheap as this boat is to make, it possesses exceptional speed and sailing qualities

off the lead until you have achieved this nice balance.

Next, make a long and a short mast from tough ⅜-in. wood, and a short bowsprit. Bore holes in the hull and step the masts firmly. Fasten the bowsprit with two fine nails or staples.

The rudder, *B*, should be rather large and weighted at the end with sheet lead. Put two screw eyes in the stern and two more, slightly open, in the rudder, hanging the rudder so that it will swing freely as the boat cants over to the wind.

Make two long, light, tough spars, and sew or lace three-cornered sails to them. Fasten the spars as at *C*. Sew a hook at the tacks and an eye at the sheets. Dressmakers' hooks and eyes will serve very well. Make a small wire ring at the end of the bowsprit for the fore tack, screw an eye in the deck for the main tack, and others for the fore and main sheets. Stretch the sails tight and, where the spars meet the masts, put eyes on the spars and hooks on the masts for connecting them.

For the sheets you will need a piece of thin cord fastened to the corner of the sail and adjusted by a small cleat such as is used for fastening tent ropes—a piece of metal or wood with two holes in it, as at *F*. A hook and eye hold the sheet, as at *G*. If you prefer, you can have the sheet single and fasten it to two nails, as shown

(*Turn to page 112*)

NEW Butter-Kist Machine Brings BIG Profits from SMALLER Investment!

BUTTER-KIST now offers a new and wonderfully improved line of Popcorn Machines with the *right* model, *exactly suited to the requirements of your own business.*

And best of all—there's a beautiful, brand-new model that sells at *half what former models cost!*

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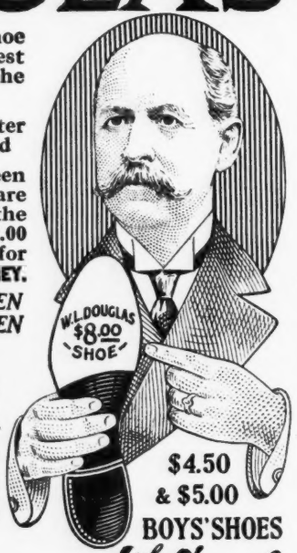

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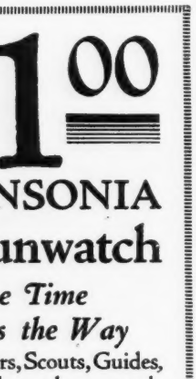

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THE HOME WORKSHOP

Barrel Head "Flyer" Yacht

(*Continued from page 111*)

at *H*, but do not leave the end trailing in the water, as it is not shipshape.

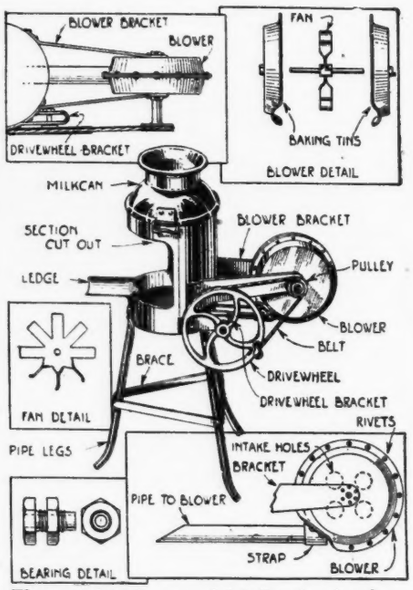
Hook the sails in position, see that they are set nice and flat, hoist your flag—the black flag suits her very well—put her in the water, and see her beat everything afloat.

The proportions shown on the drawing are about right for sail area and balance, but the amount of lead required cannot be stated, as it varies with the size of the hull and the kind of wood used. You can estimate it roughly by floating the half head on the water and putting weights on it until it is more than half under. The rudder also will have to be experimented with until the right size and weight are found.

The boat may, of course, be rigged as a cutter or in any other way desired, but the rig described has been found to go well with the hull.—E. A. M.

Simply Made Forge Is Useful Addition to Home Workshop

A COMPLETE forge and blower can be made at little cost by any mechanic handy with snips, drill, chisel, and hammer. The body is the shell of a 10-gal. milk can or similar container. An old can will serve, as rust or small holes are of no consequence. The opening, about half the width of the can, is cut with the snips. A support is made of gas pipe, three lengths being used.



The complete forge and details, showing how the blower, fan, and bearings are made

Each is flattened at one end and riveted to the rim and then braced with tie rods.

The blower has a casing made of two round baking tins. The fan is a circle of sheet iron with V-shaped notches cut out. The remaining fins are bent to form the fan blades. The fan is supported on a shaft carried by two thimbles or bearings attached to the casing. A sheet metal bracket supports the blower.

A small pulley on the fan shaft is turned by a belt from another grooved wheel, such as the driving wheel of an old sewing machine. This wheel also is mounted on a sheet iron bracket fastened to the forge, and should be provided with a handle. The forge bottom is lined with fire clay.—G. M. K.

THE HOME WORKSHOP

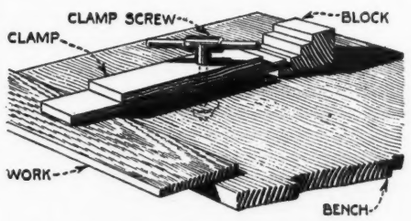
Novel Clamp for the Home Workbench Saves Time

By L. Hahner

FOR 10 years I have been using the clamping device illustrated on my workbench. It has saved much time and simplified a variety of operations. Any one who will take the trouble of making a similar attachment will find constant use for it.

It is constructed of two strips of hard wood about 3 in. wide. One should be a few inches less than the width of the bench; the other, about half as long, is nailed to the upper side of the first piece to keep it from bending.

At a point about two thirds the width of the bench from the front and the same distance from the lower end of the bench, drill a hole through the bench to receive the clamp screw. This can be simply a piece of ¾-in. pipe about 8 in. long, with a



Supplementing vise and handscrews, this cheaply made clamp has many uses in bench woodwork

long thread at one end and a short one at the other. Into the latter a pipe T is screwed firmly and a suitable handle inserted. The long thread engages an iron floor flange secured to the under side of the bench. The hole through the clamp for the pipe is located so that the end of the long arm is flush with the front edge of the bench. The short arm is supported at various heights by a step-shaped block of wood.

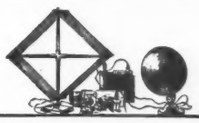
The clamp can be swung in any direction and, if in the way, detached in a few moments. It can be adjusted much more quickly than a handscrew, since only one screw has to be manipulated, and it is particularly useful for holding work that would be difficult to handle in any other way. For instance, if I wish to fasten a small board to the center of a wide one for drilling holes and driving screws, this clamp will hold the two together where the vise and handscrews would not serve. I often have to rip strips 1 in. wide, and this clamp holds them conveniently and securely. It is also valuable in assembling apparatus on a baseboard.

To Repair a Broken Fountain-Pen Barrel or Cap

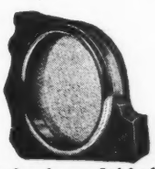
A SPLIT or cracked fountain-pen barrel can be permanently and neatly repaired by coating the damaged section with shellac and wrapping it with silk thread. The thread should be as nearly the color of the pen as can be obtained.

Wind the thread as tightly as possible; the shellac will prevent the ends from unwinding. Then apply another coat of shellac, rubbing it on well with the fingers. For best results the shellac should be thinned to the consistency of flowing varnish.—E. H. TAYLOR, Howell, Tenn.

Operate a Loud Speaker on One Tube



Erla radio frequency transformers are at the forefront of radio progress, assuring best results. Prices: Types AB1, 2, 3, $4; Reflex, $5.



Erla bezels are finished in bright nickel or dull black enamel. Telescoping rim fits any ⅛" to ¼" panel. Made in 1" and 1½" sizes. Price, 20c.

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are wound a layer at a time, with insulation wrapped between each layer. This is the reason why Stromberg-Carlson Head Sets stand up under high plate voltages.

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Rectifier for Radio B Batteries

(*Continued from page 78*)

standard lamp socket; a 40-watt bulb; a wood cover for the jar; a connecting plug, and a length of wire sufficient to reach to the outlet to which you connect the rectifier; and ½ lb. of ammonium phosphate.

It is very important that the ammonium phosphate and the aluminum strip be as pure as obtainable, otherwise the rectifier will work poorly, if at all. The solution is made by dissolving the half pound of the chemical in two quarts of water.

The construction is clearly shown in the illustration on page 80 and very little explanation is necessary. The wood cover had best be painted with pitch or asphaltum varnish, also all the joints, to prevent corrosion.

Bend one end of each strip at about the ½-in. mark. Drill two holes in each of these bent ends and attach the strips to the under side of the cover, about 1 in. apart, with brass screws, as shown.

Connecting the Rectifier

Next, mount the four binding posts, two on each side, on the top. Fasten the socket in the center. After the rectifier is wired, the solution may be poured in the jar, to within abcut ½ in. of the top, and the rectifier will be ready for operation. If the cover fits very tightly, it will be necessary to drill one or more vent holes to allow the gases to escape.

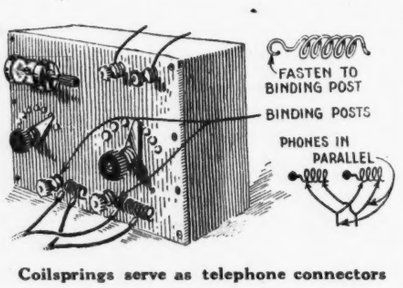
Be sure that the aluminum plate of the rectifier is connected with the positive or "plus" pole of your battery. Otherwise you might ruin it by charging in the wrong direction.

The size of batteries vary, but, when using a 40-watt lamp, a medium size battery can be fully charged in a half hour; others in proportion.

Be careful that the screws inserted on one side of the cover do not come in contact with screws projecting from the other side, as this might cause a short circuit. To prevent the creeping of the electrolyte, float a little paraffin oil on the surface.

Multiple Telephone Terminals

ANY number of telephones within reason may be attached in parallel to a radio set without extra binding posts if two coilsprings are used as shown. A loop is formed on the end of each and connected with a phone binding post. The phone terminals are then pressed between the coils, which clamp them sufficiently to insure a good electrical connection.



Coilsprings serve as telephone connectors

This device is useful primarily for crystal sets, where the phones are often connected in parallel instead of in series to lessen the resistence.—R. H. KASPER, Philadelphia, Pa.

WARREN RADIO LOOP

Direction Finding

A New Radio Pleasure

LOCATE ships at sea, trace amateur stations to their hiding places, direct your receiving in the full path of broadcasting stations.

THE type B2537 or type BL2520 Warren Radio Loop, the most compact, efficient, attractive loop aerial, is all you need. Our new Bulletin U 102 explains the fascinating art of direction finding and gives hookups.

A TYPE FOR EVERY SET AT THE BEST DEALERS

Type-A-737 (300-700 meters) 6 inches square—non-directional $10
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Send for Bulletin U-102

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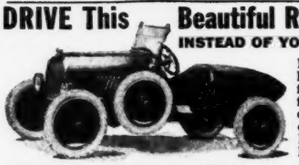
Take orders for new Serenola. Wonderful Invention. Does more than machines costing five times its price. Demand enormous. Easily carried with you anywhere. Built in just like a suitcase. Fully Guaranteed. Low priced.

Our New Plan enables you to get your money daily. Territory given. Write for terms.

PERRY-LUDLOW CO., S-1447, DAYTON, O.

DRIVE This Beautiful RACEABOUT INSTEAD OF YOUR OLD FORD



Fiat or Bullet Nose Radiator. Choice of four colors. Send for complete Catalog of Auto Bodies, Accessories and Speed Power Equipment. Direct from factory.

AMERICAN TOP AND BODY CO., Lee St., Delphi, Ind.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for April 1, 1923, State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Sumner N. Blossom, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Sumner N. Blossom, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: O. J. Ridenour, New York, N. Y.; Samuel Insul, Chicago, Ill. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

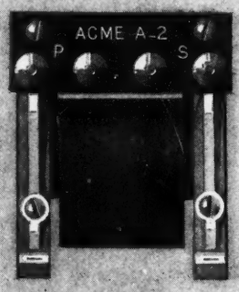
(Signed) O. B. CAPEN, *Business Manager.*

Sworn to and subscribed before me this 26th day of March, 1923.

Paul M. Bone.

(Seal) My Commission expires March 30, 1924.

ACME
for amplification



Radio Apparatus of distinction

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PIONEER TRANSFORMER AND RADIO ENGINEERS AND MANUFACTURERS
CAMBRIDGE, MASS., U. S. A.

AGENTS: $6 PER DAY AND UP

Selling concentrated, non-acoholic food flavors. Always fresh. Put up in collapsible tubes. Ten times the strength of bottled flavors. Guaranteed under U. S. pure food laws. All flavors. Sells in every home. Used every day. Not sold in stores. Big demand. Big repeater. 100% profit.

Men or Women

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FREE Radio Catalog

Our big stock of standard makes of radio sets, parts and supplies, fully illustrated. Play safe—buy standard equipment from a reliable house. We ship from stock.

Send $5.00 for Murdock Loud Speaker, including fibre horn, stand and adjustable phone unit. Requires no battery.

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In business since 1860
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YOU can earn from $1 to $2 an hour in your spare time writing show cards. Quickly and easily learned by our new simple "Instructograph" method. No canvassing or soliciting; we teach you how, guarantee you steady work at home no matter where you live, and pay you cash each week. Full particulars and Booklet Free.

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The easiest riding, raciest, most substantial wheel built—yours direct from factory—express prepaid—with 30 days' free trial.

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bicycle is guaranteed for 5 years and insured against accident for 6 months. Large variety of styles and colors

SUNDRIES Tires, horns, lamps, brake parts. Everything for the bike at wholesale prices.

Write for big catalog in colors.

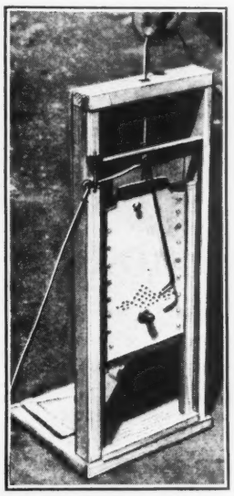
HAVERFORD CYCLE CO. OF PA.
Dept. 386 Philadelphia
Established 26 years.

Automatic Chicken Coop Door Opens for Hens at Sunrise

By Dr. Ernest Bade

AN AUTOMATIC door for the chicken coop that will open after the hens are up in the early morning can easily be constructed. It protects the chickens at night and at the same time permits them to get out for food and exercise at sunrise.

In place of springs, which rust quickly, a set of levers, a stout cord, a weight, and a pair of hinges supply the motive power. The device is so nearly foolproof that the one I built works as well now as the day it was first adjusted.

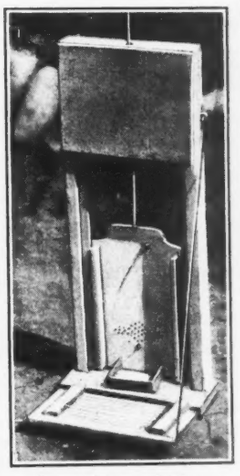


Front view of the door, showing latch

A frame twice the height of the doorway is made from 1 by 2 in. strips. The inner vertical sides of the frame are provided with grooves in which the door, made either of zinc, galvanized iron, or wood, slides easily up and down. This door is provided on the inside with a small grain holder, above which are punched a few holes to admit light.

Hinged to the lower cross member of the frame on the inside is a board as wide as the frame and 10 or 12 in. in depth. A round-headed screw in the edge of this board, preferably the edge that is later to be placed against the side of the coop, carries a loop at one end of a stiff wire. The wire should be long enough almost to reach the top of the frame.

At the upper end of the wire is another loop, and slightly above it is placed a cross bar sunk about ½ in. into the frame. Another round-headed screw is fastened to the center of this bar, and a wire bent around it in such a way that one end engages the loop of the long wire while the other end hangs downward.



The tilting platform and grain holder at rear of door

Near the top of the sliding door a metal knob or bolt is firmly fixed and another one is placed near the bottom. When the door is closed the long, free end of the wire hanging from the center of the cross piece is bent so as to hook directly above the small upper knob. At the same time the hinged board in the rear should be raised approximately ¾ in.

A small piece of wire with a loop is at-

(*Turn to page 116*)

What would you do in his place?

The steeplejack lights his pipe and goes on painting

Imagine, if you can, a steeplejack 487 feet above the street level. Hanging on by his teeth he is applying a more or less rough-and-ready coat of paint to a flagpole.

Right in the midst of a busy morning's painting an adventurous bee buzzes into the picture. In fact, there are two bees, both buzzing viciously.

What should the steeplejack do?

There being in the profession no local rules for buzzing bees, your average steeplejack probably would get the all-clear signal from below and slide proptly down to safety.

But not Our Hero.

He takes out his pipe, lights it, and goes on painting.

"It soothes the nerves," he says frankly about pipe smoking.

We have no way of knowing what kind of tobacco the steeplejack pours into his pipe on these bee-buzzing occasions, but we have a feeling that it is Edgeworth.

For Edgeworth does much to give the smoker a sense of calm and peaceful security.

Of course we wouldn't care to go on record as claiming that smoking a can of Edgeworth is as good as a two-weeks rest cure in the mountains; but we would like to register very strongly the opinion that smoking any pipe makes life seem more worth living and that smoking a pipe filled with Edgeworth helps a lot.

If you are interested in finding out more about Edgeworth, the most sensible plan is for you to let Larus & Brother Company send you some free samples so that you can try the tobacco for yourself.

Just write your name and address down on a postcard and you will receive immediately generous helpings both of Edgeworth Plug Slice and Ready-Rubbed. If you will also include the name and address of your tobacco dealer, we will make it easier for you to get Edgeworth regularly.

For the free samples address Larus & Brother Company, 59 South 21st Street, Richmond, Virginia.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Own This GENUINE DROP FORGED STEEL ASTRA AUTOMATIC

Buy Direct from Sole U.S. Importers and Save 1/2

The ASTRA is the finest European Pistol and the equal of any similar American weapon retailing at $15 and $25 up! It is the standard of the Spanish Army, and after exhaustive tests was adopted by the French Army during the war. The **ASTRA** has heretofore always been sold through retail stores, but the competition of cheap cast iron pistols has forced us to sell **Direct to You,** ELIMINATING THREE PROFITS—**Jobber, Wholesaler and Retailer!**

WARNING! Cast iron guns are very dangerous! We **Guarantee** the **ASTRA** is of **Drop-Forged Steel throughout!** Before buying any weapon, **INSIST** on this guarantee. We also absolutely guarantee the **ASTRA** against inferior workmanship! If you are not entirely satisfied, return within 10 days and we will immediately refund your money.

SEND NO MONEY

—unless you wish. Fill out coupon, write name and address plainly, showing gun you wish. We will ship by return mail.

$8.95 25 Caliber 7 Shot Automatic — With Triple Safety $9.95 — $10.95 32 CALIBER 10 SHOT AUTOMATIC Including Extra Magazine

BOTH MODELS SHOOT ANY STANDARD AMMUNITION

.25 cal. model, 4 5/8 in. long by 3 1/4 in. high—an ideal gun for a man or woman. Substantial .32 cal. military model 6 1/4 in. long by 4 3/4 in. high. Blue steel, beautifully balanced, swift—accurate! Superb workmanship and materials throughout. A gun you will be proud to own. Write for free catalog.

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In accordance with the terms of your advertisement, send me.....ASTRA AUTOMATIC. I am enclosing money order for..... Or, I will pay postman on arrival.

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Earn $50 a day

Selling men's gas-mask

GOODYEAR RAINCOATS

$1.90 each, in dozen or gross lots. Sample sent upon receipt of $2.15. *Agents wanted.* (*Write for our 6 best sellers.*)

GOODYEAR RUBBER M'F'G CO.
Dept. C - - 34 E. 9th Street, N. Y. C.

Save $50 — A WEEK'S FREE TRIAL Read Below — Easy Terms

New OLIVER With Standard Keyboard

Here it is. Our NEW Oliver, "Quiet Speedster" Model, with every modern improvement and refinement including the standard 3-bank keyboard, so any typist can use it at once without loss of speed or output. The easiest machine and keyboard for beginners. And we GUARANTEE to save you $25 to $50, or more, on the price of other standard machines This is the finest typewriter we have ever built. The fastest, most silent, easiest to operate.

FREE TRIAL—Write Today

We will send you this latest and greatest Oliver on FREE TRIAL for a week. Test it. Use it. Compare its speed, its typing, its appearance. Note the simple durability and strength. Then if you are convinced it is the best typewriter you ever used pay for it at our SPECIAL LOW PRICE on time or for cash. If not return it at our expense. *You run no risk.*

CATALOG FREE—Write Today

Write AT ONCE for our FREE catalog, 1923 edition. It will explain to you WHY and HOW we can afford to sell you this new typewriter for $25 to $50 less than other standard machines. Get our **free trial offer,** our terms and cash discount. This request places you under no obligation.

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The Lightest, Speediest and Most Durable Outboard Motor in the World.

Almost as Easy to Carry as a Pair of Oars

Makes a speedy power boat or pleasure launch of any boat or canoe. A boy or girl can handle it. The whole family enjoy it. 2 H. P. Twin Cylinder.

Weighs Only 35 Lbs.

15 to 50 pounds less than usual, yet guaranteed more durable. Has real carburetor, real magneto—no batteries to carry—spark and throttle control like auto, instant reverse, self tilting and ten other valuable features. Write for Free Catalog folder today.

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EASTERN OFFICE—120 Broadway, New York City

Johnson "WATER-BUG"

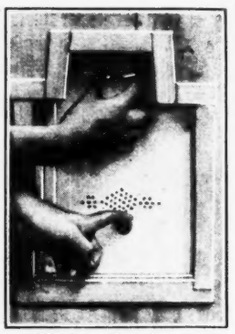
THE LIGHTEST, LIVELIEST BOAT MOTOR ON THE WATER.

THE HOME WORKSHOP

Automatic Chicken Coop Door

(*Continued from page 115*)

tached near the top and center of the door and from it a strong cord is carried directly upward through a hole bored in the upper member. Pulling on this cord will not raise the door as long as the hook end of the L lever is in place directly over the knob in the door, but when a slight pressure or weight is exerted or placed on the hinged board, the hook moves out of the way and the board will then rise when the cord is pulled. When the loops and wires are arranged correctly, this simple latch will be found foolproof.

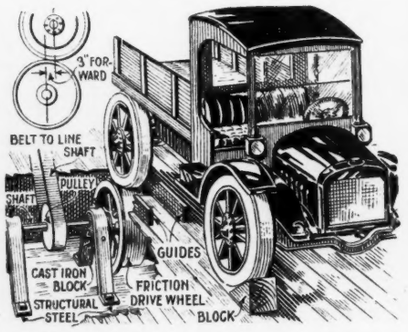


Closing the door at night

The whole frame is attached to the coop, inside the doorway, and the cord is carried up and over two pulleys. A weight made with a can filled with pebbles is attached to the cord. At night, after a little grain has been placed in the grain box, the door is closed by being pulled downward and latched with the hook. Next morning the chickens, in going for the grain, trip the latch and the door opens. The food on the door lasts about a week, since as soon as the door is tripped the food goes out of reach.

Motor Truck Drives Pulley through Friction Wheel

MOST power take-offs for utilizing the motor of a passenger or commercial automobile require the rear end of the car to be jacked up and fastened securely before the motor can be started or the clutch engaged. This is not necessary, however, with the attachment illustrated, which is suitable for concrete mixing,



This power take-off makes it unnecessary to jack up the truck before using it as a power plant

sawing, driving farm machinery, and other purposes. The car can be driven directly on the power take-off without any preliminary work.

The friction pulley is simply a wide-tired wagon or car wheel running in ball or roller bearings that are mounted below the shop or barn floor. A belt pulley is also keyed to the drive wheel shaft.

The car, guided by two short planks spiked to the floor, is driven over the center of the friction wheel, and the front wheels are held in place against a suitable stop.

The Shipshape Home
How To Do the Odd Jobs

Decorating Painted Walls

THE crackled or figured effect on painted walls now so much in vogue can be obtained quite easily by the home worker. It does not require the services of an expert decorator. Patting the wet paint lightly with crumpled newspaper or wrapping paper or with a well-wrinkled but lintless rag is what does the trick.

Usually two harmonious tones are used, one for the under coat and the other for the top coat, so that when the surface is figured, the under coat will show through the various lines and crackle marks. The first thing to do, therefore, is to select the colors desired and apply the first coat.

If the wall has previously been painted, it is necessary only to clean the old paint thoroughly with soap and water. A newly plastered wall and certain kinds of wallboard must first be primed with a varnish size or size and flat oil paint mixed together. Many varieties of wallboard, however, are already primed, so that the under coat can be applied directly to them.

Not until the under coat is thoroughly dry should the finishing coat be started. Much of the success of the operation depends upon using good taste in selecting the colors, and it is worth while to go to considerable pains in making preliminary trials on a waste piece of plaster board, or even on a large sheet of heavy wrapping paper before finally settling on the finishing coat. For subdued, delicate effects, there should not be much difference between the two coats; it is sufficient to add a little color to the top coat to lighten, darken or brighten the paint used for the under coat, as seems most desirable. For more brilliant effects, such as for a nursery or a dark hallway, the contrast between the two coats can be much greater.

Now paint a strip of the wall several feet wide, about as far as you can reach conveniently without moving, and, while the paint is still wet, crumple up a newspaper sheet into a wad and tap the paint lightly, working from left to right and from the top down. Press the wad against the paint firmly enough so that the wrinkles will leave an impression, but do not shift it along the wall on the paint, as that will blur the effect. Keep turning the wad so as to present new surfaces to the paint. Then add another strip of color and proceed in the same way. When the paper becomes covered with paint, throw it away.

The figured effect will vary according to how tightly the paper is crumpled and how hard it is pressed against the wall. A sharper effect can be obtained by using a stiffer paper, such as cheap wrapping

(*Turn to page 118*)

Memo Pad

What I will need to make a good tube set

A Kellogg No. 501 variocoupler
A Kellogg No. 605 variable condenser
A Kellogg No. 2 tube socket
A Kellogg No. 505 miniature condenser
A Kellogg No. 503 mounting
A Kellogg No. 609 radio resistance
A Kellogg No. 502 dial
A Kellogg No. 69A head set
A Kellogg No. 501 rheostat
A Kellogg switch and switch points
A and B batteries and cabinet
A Detector tube
Kellogg radio equipment is recommended for several reasons

First — It is easy to install and simple to operate.

Second — It is built of the highest grade material to give the best possible results.

Third — It is electrically and mechanically correct and will last a life time.

Fourth — It is built by the Kellogg Switchboard and Supply Co., who have manufactured high grade telephone equipment for the past 25 years.

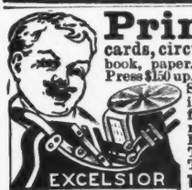
Fifth — Every Kellogg radio part is GUARANTEED by the manufacturer.

"Use, is the test."

Get the above apparatus from your dealer

Kellogg Switchboard and Supply Co., Chicago

Print Your Own cards, circulars, labels, tags, menus book, paper. Press $12. Larger $35. Job Press $150 up. CUTS EXPENSE IN HALF. SMALL OUTLAY. Pays for itself in short time. Will last for years. Easy to use, printed rules sent. Print for others, BIG PROFIT. Write factory TODAY for press catalog, TYPE, cards, paper, envelopes.



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$25 A DAY Selling Shirts

Large shirt manufacturer wants agents to sell complete line of shirts, pajamas and night shirts direct to wearer. Advertised brand—exclusive patterns—easy to sell. No experience or capital required. Entirely new proposition. *Write for free samples.*

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COOK AND BAKE
With Amazing New Invention

No More Sweltering Kitchens in Summer—No More Fires to Build—No More Dirty Heavy Coal—No More Ashes in House—No More Scuttles to Empty—No More Smelly, Sooty Oil Stoves to Clutter Kitchen. No More Spoiled Roasts, Bread or Cake from Uncertain Oven.

Makes Your Range A REAL GAS STOVE

An amazing new invention has ended forever the days of woman's slavery to all kinds of household drudgery. The Oliver Oil-Gas Burner—makes any coal or wood range a real gas stove—*on and off with a valve.* Gives much or little heat—only when you want it—at a twist of your wrist.

Wonderful Baking Bake right in your good old oven—better and quicker than ever before. No need for keeping a hot fire going all day. You want a batch of bread or biscuits, a light fluffy cake or pies; or you wish to prepare a meal simply turn a valve and *light your fire.* In a jiffy the oven is at a fine even temperature—any degree you want. Put in your roast or baking—put on your stew of vegetables. Go away and forget them. Come back when they are done—turn the *fire out instantly*—and your kitchen is cool and clean.

AGENTS

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I give Fords to my producers. The big Summer Season is just starting. Write today. Address me personally, Mr. B. M. Oliver, President, at address shown on coupon.

Burns 95% Air, 5% Oil

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Name _____
Address _____
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5000 More Driver AGENTS WANTED

Guaranteed SALARY or Commissions!

$50 to $200 A WEEK

STOP wasting your time on hard-to-sell SMALL PROFIT lines. What bigger opportunity for making money can you find than selling the ONLY auto lubricating system which uses *heavy oil* under 2000 lbs. pressure! Grease and oil-cups, greasing systems, now out of date. "Only 100% lubrication" say engineers of the SAAL Heavy Oil System.

2000 lbs. Hydraulic Pressure

Heavy oil 100% Lubrication

$5.00 for FORD, OVERLAND, CHEVROLET, STAR, GRAY

$8.00 for ALL OTHER CARS

AS EASY TO USE AS AN OIL CAN

SAAL HEAVY OIL System

100% lubrication

42 Fittings included—fit all CARS

Saves Repairs, Depreciation!

Less than half price of other systems but pays for itself quick in repair bills and depreciation saved. Lubricates steering, shackles, entire chassis. So easy to use *you actually use it!* Makes lubricating a white-collar job, and you get service-station results. Cheapest insurance the car-owner can buy!

30 Days' FREE TRIAL Offer!

Agents without selling experience are selling 9 out of 10 calls simply by following our instructions. FREE TRIAL and money-back offer gets them all. No investment, no waiting for your profits, no delivering or collecting. Sell dealers, garages, motorists.

DEALERS! Leading auto-makers have adopted "SAALS" as standard equipment. Standard Oil Co., Western Electric Co., and many similar corporations have equipped every truck with "SAALS." Coupon brings biggest profit-making opportunity of 1923. Mail it today!

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Dept. 206, 1800 Montrose Avenue, CHICAGO

Agents! GET YOURS FREE!

Complete outfit for your own car, SAAL OIL-SHOOTER and 42 fittings, given absolutely FREE! Territory rights will be granted to driver-agents first to start producing in every locality. 15 million "SAALS" will be sold—$30,000,000.00 will be divided among our Agents.

No money in waiting, don't let others skim off all the cream. Get the facts, then act!

Mail Coupon Today! Don't Wait!

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Address.....

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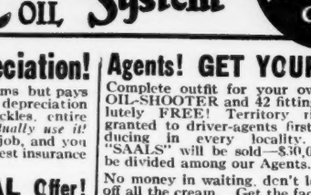

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THE HOME WORKSHOP

The Shipshape Home

(*Continued from page 117*)

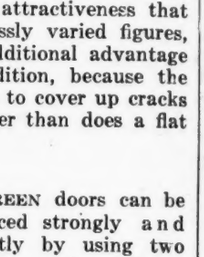
paper; and a softer effect by using cloth. If any part of the surface is accidentally blurred, simply paint it over again and refinish.

Any good commercial flat wall paint for interior decoration can be used with this process. Besides the attractiveness that comes from the endlessly varied figures, this process has an additional advantage for walls in bad condition, because the irregular pattern tends to cover up cracks and blemishes far better than does a flat coat.—D. A. L.

Bracing Doors

SCREEN doors can be braced strongly and neatly by using two heavy sheet iron angles about ¾ in. wide and 6 in. long. One angle is screwed to the door stile and the other to the upper rail, and the two are then drawn together by means of a stove bolt through the bent up ends, as shown.

The brace can always be tightened by setting up the screw with a screwdriver. This fixture is less unsightly than the frequently used method of carrying a heavy double wire across the frame and twisting it tight.—FREDERICK POTTER.



Stains and Staining

STAINS are available in so many varieties, tints, and shades for the amateur painter, that it is difficult to choose the best one for a particular purpose.

Oil stains are used quite often where no filling is desired and on soft woods. They are applied with a brush or a cloth and wiped off with a cloth, either immediately afterward or after an interval of ten or fifteen minutes. They go on evenly, although they are not so transparent and do not penetrate to the same extent as other stains. Oil or spirit stains are always recommended for use in staining old work.

For small jobs where unusual coloring is needed, the home worker can profitably mix a little oil stain himself. To do this it is necessary to have on hand a small amount, perhaps ten cents' worth, of each of several powdered colors, such as raw umber, burnt sienna, lampblack and bright green, yellow, red, and blue. These can be mixed with boiled linseed oil and a little turpentine to make endless color combinations.

Water and acid stains are put on with a brush or sponge. Since they penetrate the wood well and are thoroughly transparent, they are frequently used for hard woods before filling. They have a tendency to "raise" the grain so that if they are to be used on a surface that is not to be filled, it is advisable to moisten the wood with plain water and after that has dried, to sandpaper it well before applying the stain.

Spirit stains are applied like oil stains, but require somewhat quicker handling and do not cover nearly as much surface as water stain. They can be shellacked, waxed, or varnished almost immediately.—M. K.

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Why do you do it?
O' HELLO LIL. SAY, THE SMITHS ARE COMIN' OVER TNIGHT
AN' A GOOD PROGRAM ON TOO, O BOY!!
I'LL SEE HOW SHE'S WORK-ING—
GOSH— NO SOUND
DARN— NO JUICE— AND HERE THEY COME
R-I-N-G-
AW-W-HULLO
HELLO, JOE. WHAT'S UP-Y LOOK BLUE
JUST TNIGHT MY BATTRY GOES SOUR, AN' NOW I'LL HAVE T'LUG IT OUT TO GET IT RE-CHARGED!
BUT LISSEN JOE
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